RHO-CD-673
Volume III
012795 3 of 3

Handbook
200 Areas Waste Sites

Prepared for the United States
Department of Energy
Under Contract EY-77-C-06-1030

Rockwell International

Rockwell Hanford Operations
Energy Systems Group
Richland, WA 99352

Volume III

RHO-CD-673

HANDBOOK

200 AREAS WASTE SITES

Compiled by

H. L. Maxfield
Under Contract W7C-SBB-31873

April 1, 1979

ROCKWELL HANFORD OPERATIONS
RICHLAND, WASHINGTON 99352

Operated for the Department of Energy
by Rockwell Hanford Operations
under Contract EY-77-C-06-1030

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Rockwell International

Rockwell Hanford Operations
Energy Systems Group

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INTRODUCTION

Document RHO-CD-673 has been written as a handbook of radioactive waste sites and associated radiation areas within the 200 Areas and related environs. It does not include those sites within the confines of the Tank Farms.

It is primarily an updating and extension of the 200 Areas section of Document BNW-MA-88 (Resource Book - Disposition [Decontamination and Decommissioning] of Retired Contaminated Facilities at Hanford).

The document consists of three volumes:

Volume I - Contains information about those sites within the 200 East Area.

Volume II - Contains information about those sites within the 200 West Area.

Volume III - Contains information about those sites East of 200 East Area, south of 200 East Area, south of 200 West Area, within the 200 North Area, and the Gable Mountain Storage Vaults.

Volumes I and II are each divided into four sections called Quadrants: the northeast quadrant is indexed NE, the southeast quadrant - SE, the southwest quadrant - SW, and the northwest quadrant - NW.

Volume III is divided into quandrants containing those sites east of 200 East Area, indexed E-200 E; those south of 200 East Area, indexed S-200 E; those south of 200 West Area, indexed S-200 W; those in the 200 North Area, indexed 200 N; and the Gable Mountain Vaults, indexed Gable Mountain.

Each of the three volumes contain a master numerical index listing all of the sites by number and quadrant. In the front of each quadrant is an index of those sites within that quadrant.

Each volume contains indexes of Burial Grounds, Unplanned Release Sites, Ditches, Ponds, and Retention Basins.

All information concerning a site, such as maps, illustrations and photos, have been grouped with that site.

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
216-A-1	Crib	III. E-200 E
216-A-2	Crib	I. SE
216-A-3	Crib	I. SE
216-A-4	Crib	I. SE
216-A-5	Crib	I. SE
216-A-6	Crib	III. E-200 E
216-A-7	Crib	III. E-200 E
216-A-8	Crib	III. E-200 E
216-A-9	Crib	I. SE
216-A-10	Crib	I. SE
216-A-11	French Drain	I. SE
216-A-12	French Drain	I. SE
216-A-13	French Drain	I. SE
216-A-14	French Drain	I. SE
216-A-15	French Drain	I. SE
216-A-16	French Drain	I. SE
216-A-17	French Drain	I. SE
216-A-18	Crib	III. E-200 E
216-A-19	Crib	III. E-200 E
216-A-20	Crib	III. E-200 E
216-A-21	Crib	I. SE
216-A-22	Crib	I. SE
216-A-23A	French Drain	I. SE
216-A-23B	French Drain	I. SE
216-A-24	Crib	III. E-200 E
216-A-25	Pond	III. E-200 E
216-A-26A	French Drain	I. SE
216-A-26B	French Drain	I. SE
216-A-27	Crib	I. SE
216-A-28	Crib	I. SE
216-A-29	Ditch	III. E-200 E
216-A-30	Crib	III. E-200 E
216-A-31	Crib	I. SE
216-A-32	Crib	I. SE
216-A-33	French Drain	I. SE
216-A-34	Crib	III. E-200 E
216-A-35	French Drain	I. SE
216-A-36A	Crib	I. SE
216-A-36B	Crib	I. SE
216-A-37	Crib	III. E-200 E
216-A-38	Crib	I. SE
216-A-39	Crib	I. SE
216-A-40	Crib	I. SE
216-A-41	Crib	I. SE
216-A-42	Trench	III. E-200 E

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
216-B-1	Crib (not built)	
216-B-2-1	Ditch	I. NE
216-B-2-2	Ditch	I. NE
216-B-2-3	Ditch	I. NE
216-B-3	Pond	III. E-200 E
216-B-3-1	Ditch	III. E-200 E
216-B-3-2	Ditch	III. E-200 E
216-B-3-3	Ditch	III. E-200 E
216-B-4	Reverse Well	I. SW
216-B-5	Reverse Well	I. NE
216-B-6	Reverse Well	I. SW
216-B-7A	Crib	I. NE
216-B-7B	Crib	I. NE
216-B-8	Crib and Tile Field	I. NE
216-B-9	Crib and Tile Field	I. NE
216-B-10A	Crib	I. SW
216-B-10B	Crib	I. SW
216-B-11A	Reverse Well	I. NE
216-B-11B	Reverse Well	I. NE
216-B-12	Crib	I. NW
216-B-13	French Drain	I. SW
216-B-14	Crib	III. S-200 E
216-B-15	Crib	III. S-200 E
216-B-16	Crib	III. S-200 E
216-B-17	Crib	III. S-200 E
216-B-18	Crib	III. S-200 E
216-B-19	Crib	III. S-200 E
216-B-20	Trench	III. S-200 E
216-B-21	Trench	III. S-200 E
216-B-22	Trench	III. S-200 E
216-B-23	Trench	III. S-200 E
216-B-24	Trench	III. S-200 E
216-B-25	Trench	III. S-200 E
216-B-26	Trench	III. S-200 E
216-B-27	Trench	III. S-200 E
216-B-28	Trench	III. S-200 E
216-B-29	Trench	III. S-200 E
216-B-30	Trench	III. S-200 E
216-B-31	Trench	III. S-200 E
216-B-32	Trench	III. S-200 E
216-B-33	Trench	III. S-200 E
216-B-34	Trench	III. S-200 E
216-B-35	Trench	I. NW
216-B-36	Trench	I. NW
216-B-37	Trench	I. NW
216-B-38	Trench	I. NW
216-B-39	Trench	I. NW

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
216-B-40	Trench	I. NW
216-B-41	Trench	I. NW
216-B-42	Trench	I. NW
216-B-43	Crib	I. NW
216-B-44	Crib	I. NW
216-B-45	Crib	I. NW
216-B-46	Crib	I. NW
216-B-47	Crib	I. NW
216-B-48	Crib	I. NW
216-B-49	Crib	I. NW
216-B-50	Crib	I. NW
216-B-51	French Drain	I. NW
216-B-52	Trench	III. S-200 E
216-B-53A	Trench	III. S-200 E
216-B-53B	Trench	III. S-200 E
216-B-54	Trench	III. S-200 E
216-B-55	Crib	I. NW
216-B-56	Crib	I. NE
216-B-57	Crib	I. NW
216-B-58	Trench	III. S-200 E
216-B-59	Trench	I. NE
216-B-60	Crib	I. NW
216-B-61	Crib	I. NW
216-B-62	Crib	I. NW
216-B-63	Trench	I. NE
216-C-1	Crib	I. SE
216-C-2	Reverse Well	I. SE
216-C-3	Crib	I. SE
216-C-4	Crib	I. SE
216-C-5	Crib	I. SE
216-C-6	Crib	I. SE
216-C-7	Crib	I. SE
216-C-8	French Drain	I. NE
216-C-9	Pond	I. NE
216-C-10	Crib	I. SE
216-S-1 & 2	Cribs	II. SE
216-S-3	Crib	II. SE
216-S-4	French Drain	II. SW
216-S-5	Crib	III. S-200 W
216-S-6	Crib	III. S-200 W
216-S-7	Crib	II. SE

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
216-S-8	Trench	II. SE
216-S-9	Crib	II. SE
216-S-10	Ditch and Pond	III. S-200 W
216-S-11	Pond	III. S-200 W
216-S-12	Trench	II. SE
216-S-13	Crib	II. SE
216-S-14	Trench (released)	III. S-200 W
216-S-15	Pond	II. SE
216-S-16	Pond	III. S-200 W
216-S-17	Pond	III. S-200 W
216-S-18	Crib	II. SE
216-S-19	Pond	III. S-200 W
216-S-20	Crib	II. SE
216-S-21	Crib	II. SW
216-S-22	Crib	II. SE
216-S-23	Crib	II. SE
216-S-24	Crib (not built)	II. SE
216-S-25	Crib	III. S-200 W
216-T-1	Ditch	II. NE
216-T-2	Reverse Well	II. NE
216-T-3	Reverse Well	II. NE
216-T-4-1	Ditch	II. NW
216-T-4-1	Pond	II. NW
216-T-4-2	Ditch	II. NW
216-T-4-2	Pond	II. NW
216-T-5	Crib	II. NW
216-T-6	Crib	II. NE
216-T-7	Crib	II. NW
216-T-8	Crib	II. NE
216-T-9	Trench	II. NE
216-T-10	Trench	II. NE
216-T-11	Trench	II. NE
216-T-12	Pit	II. NE
216-T-13	Trench (exhumed)	II. NW
216-T-14	Trench	II. NE
216-T-15	Trench	II. NE
216-T-16	Trench	II. NE
216-T-17	Trench	II. NE
216-T-18	Crib	II. NE
216-T-19	Crib and Tile Field	II. NW

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
216-T-20	Crib	II. NE
216-T-21	Trench	II. NW
216-T-22	Trench	II. NW
216-T-23	Trench	II. NW
216-T-24	Trench	II. NW
216-T-25	Trench	II. NW
216-T-26	Crib	II. NE
216-T-27	Crib	II. NE
216-T-28	Crib	II. NE
216-T-29	French Drain	II. NE
216-T-30	Unplanned Release Site	II. NE
216-T-31	French Drain (exhumed)	II. NW
216-T-32	Crib	II. NW
216-T-33	Crib	II. NE
216-T-34	Crib	II. NE
216-T-35	Crib	II. NE
216-T-36	Crib	II. NW
216-U-1	Crib	II. SE
216-U-2	Crib	II. SE
216-U-3	French Drain	II. SE
216-U-4	Reverse Well	II. SE
216-U-4A	Dry Well	II. SE
216-U-4B	Dry Well	II. SE
216-U-5	Trench	II. SE
216-U-6	Trench	II. SE
216-U-7	French Drain	II. SE
216-U-8	Crib	II. SE
216-U-9	Ditch	III. S-200 W
216-U-10	Pond	II. SW
216-U-11	Old Trench	III. S-200 W
216-U-11	New Trench	III. S-200 W
216-U-12	Crib	II. SE
216-U-13	Crib	II. SW
216-U-14	Ditch	II. SE
216-U-15	Crib	II. SE
216-Z-1	Ditch	II. SW
216-Z-1 & Z-2	Cribs	II. SW
216-Z-1A	Tile Field	II. SW
216-Z-1AA	Tile Field	II. SW
216-Z-1AB	Tile Field	II. SW
216-Z-1AC	Tile Field	II. SW

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
216-Z-3	Crib	II. SW
216-Z-4	Crib	II. NW
216-Z-5	Crib	II. NW
216-Z-6	Crib	II. NW
216-Z-7	Crib	II. NW
216-Z-8	French Drain	II. SW
216-Z-9	Crib	II. SW
216-Z-10	Reverse Well	II. NW
216-Z-11	Ditch	II. SW
216-Z-12	Crib	II. SW
216-Z-13	French Drain	II. SW
216-Z-14	French Drain	II. SW
216-Z-15	French Drain	II. SW
216-Z-16	Crib	II. NW
216-Z-17	Trench	II. NW
216-Z-18	Crib	II. SW
216-Z-19	Ditch	II. SW
	BURIAL GROUNDS	
218-E-1	Burial Ground	I. SE
218-E-2	Burial Ground	I. NW
218-E-2A	Burial Ground	I. NW.
218-E-3	Exhumed	
218-E-4	Burial Ground	I. NW
218-E-5	Burial Ground	I. NW
218-E-5A	Burial Ground	I. NW
218-E-6	Exhumed	
218-E-7	Vault	I. SW
218-E-8	Burial Ground	I. NE
218-E-9	Equipment Storage	I. NW
218-E-10	Burial Ground	I. NW
218-E-12A	Burial Ground	I. NE
218-E-12B	Burial Ground	I. NE
218-E-13	Burial Site	I. SE
218-E-14	Burial Tunnel	I. SE
218-E-15	Burial Tunnel	I. SE

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
218-W-1	Burial Ground	II. NW
218-W-1A	Burial Ground	II. NE
218-W-2	Burial Ground	II. NW
218-W-2A	Burial Ground	II. NW
218-W-3	Burial Ground	II. NW
218-W-3A	Burial Ground	II. NW
218-W-4A	Burial Ground	II. NW
218-W-4B	Burial Ground	II. NW
218-W-4C	Burial Ground	II. SW
218-W-7	Vault	II. SE
218-W-8	Vault	II. NE
218-W-9	Burial Site	II. SE
218-W-11	Burial Ground	II. NW

UNPLANNED RELEASE SITES - 200 EAST AREA

UN-216-E-1	Ground Contam.	Div. Box 241-B-151	I. NE
UN-216-E-2	Ground Contam.	Div. Box 241-B-152	I. NW
UN-216-E-3	Ground Contam.	Div. Box 241-B-153	I. NE
UN-216-E-4	Line Break	241-B-153	I. NE
UN-216-E-5	Ground Contam.	Div. Box 241-B-154	I. NE
UN-216-E-6	Ground Contam.	Div. Box 241-BX-155	I. NW
UN-216-E-7	Line Break	242-B to 207-B	I. NE
UN-216-E-8	Line Break	221-B, R-3	I. NW
UN-216-E-9	Line Break	241-CR-151	I. NE
UN-216-E-10	Line Break	211-C-152	I. NE
UN-216-E-11	Ground Contam. B-C Cribs Area	Controlled	III. S-200 E
UN-216-E-12	Catch Tank Leak	241-ER-151	I. SW
UN-216-E-13	Line Break	221-B, R-13	I. NW
UN-216-E-14	Line Break	241-C, SW corner	I. NE
UN-216-E-15	Line Leak	224-B, Backside	I. SW

INDEX - MASTER NUMERICAL

Number	Type	Volume and Quadrant
	UNPLANNED RELEASE SITES - 200 WEST AREA	
UN-216-W-2	207-S Retention Basin Contamination	II. SE
UN-216-W-4	Ground Contam. North of 233-S	II. SE
UN-216-W-5	Line Break 23rd & Camden	II. NE
UN-216-W-6	Line Break 221-T, R-19	II. NE
UN-216-W-7	Ground Contam. East of 241-TX	II. NE
UN-216-W-9	Ground Contam. 221-U, R-3 - R-5	II. SE
UN-216-W-11	221-U Vessel Vent Blower Pit Contam.	II. SE
UN-216-W-12	Line Leak Backside 224-T	II. NE
UN-216-W-13	Line Break 216-Z-18 Crib Line	II. SW
UN-216-W-14	Leach Trench NE 216-U-10 Pond	II. SW
UN-216-W-15	Leach Trench E. 216-U-10 Pond-N.	II. SW
UN-216-W-16	Leach Trench E. 216-U-10 Pond-S.	II. SW
UN-216-W-17	Overflow Plain Southside 216-U-10 Pond	II. SW
UN-216-W-18	Line Break South end 216-S-9 Crib	II. SE
UN-216-W-19	Line Break East side 218-W-9	II. SE
UN-216-W-20	Pu Spoil Trench Near 216-Z-1 Ditch	II. SW
UN-216-W-21	Sludge Pits South side 207-U	II. SE
UN-216-W-22	Sludge Pits North side 207-U	II. SE
UN-216-W-23	Ground Contam. Hillside West of 241-TX-155	II. NE

INDEX - DITCHES

Number	Type	Volume and Quadrant
216-A-29	Purex Chem. Sewer	III. E-200 E
216-B-2-1	B Covered Ditch	I. NE
216-B-2-2	B Covered Ditch	I. NE
216-B-2-3	B Ditch Presently in Use	I. NE
216-B-3-1	B Covered Ditch - E. of 200 East	III. E-200 E
216-B-3-2	B Covered Ditch - E. of 200 East	III. E-200 E
216-B-3-3	B Ditch, E. of 200 East, Pres. in Use	III. E-200 E
216-S-10	Redox Chemical Sewer	III. S-200 W
216-T-1	221-T Head End	II. NE
216-T-4-1	T-Plant Old Covered Ditch	II. NW
216-T-4-2	T-Plant Ditch - Presently in Use	II. NW
216-U-9	Overflow Ditch to 216-S-16 & 17 Partially Covered - Not in Use	III. S-200 W
216-U-11	Overflow from U-10 Pond	III. S-200 W
216-U-14	Laundry Ditch	II. SE
216-Z-1	Z-Plant Buried Ditch	II. SW
216-Z-11	Z-Plant Buried Ditch	II. SW
216-Z-19	Z Plant Ditch, Presently in Use	II. SW

INDEX - PONDS

Number	Type	Volume and Quadrant
216-A-25	Pond, Gable Mountain	III. E-200 E
216-B-3	Pond, B Plant	III. E-200 E
216-C-9	Pond, Bottom of 221-C excavation	I. NE
N-1	200 N Area - Released from Rad. Zone	III. 200 N
N-4	200 N Area - (Covered)	III. 200 N
N-6	200 N Area - (Covered)	III. 200 N
216-S-10	Old Redox Leach Pond	III. S-200 W
216-S-11	Old Redox Leach Pond (East of S-10)	III. S-200 W
216-S-15	Covered Small Pond - East of 241-S	II. SE
216-S-16	Redox Covered Ponds	III. S-200 W
216-S-17	Redox Covered Pond	III. S-200 W
216-S-19	222-S Lab Pond	III. S-200 W
216-T-4-1	T-Plant Pond - Released from Rad. Zone	II. NW
216-T-4-2	T-Plant New Pond - Not Contaminated	II. NW
216-U-10	U-Pond	II. SW

INDEX - RETENTION BASINS

Number	Type	Volume and Quadrant
207-A	242-A Evaporator	III. E-200 E
207-B	B-Plant	I. NE
207-S	Redox (covered)	II. SE
207-SL	Redox Laboratory	II. SE
207-T	T-Plant	II. NE
207-U	U-Plant	II. SE

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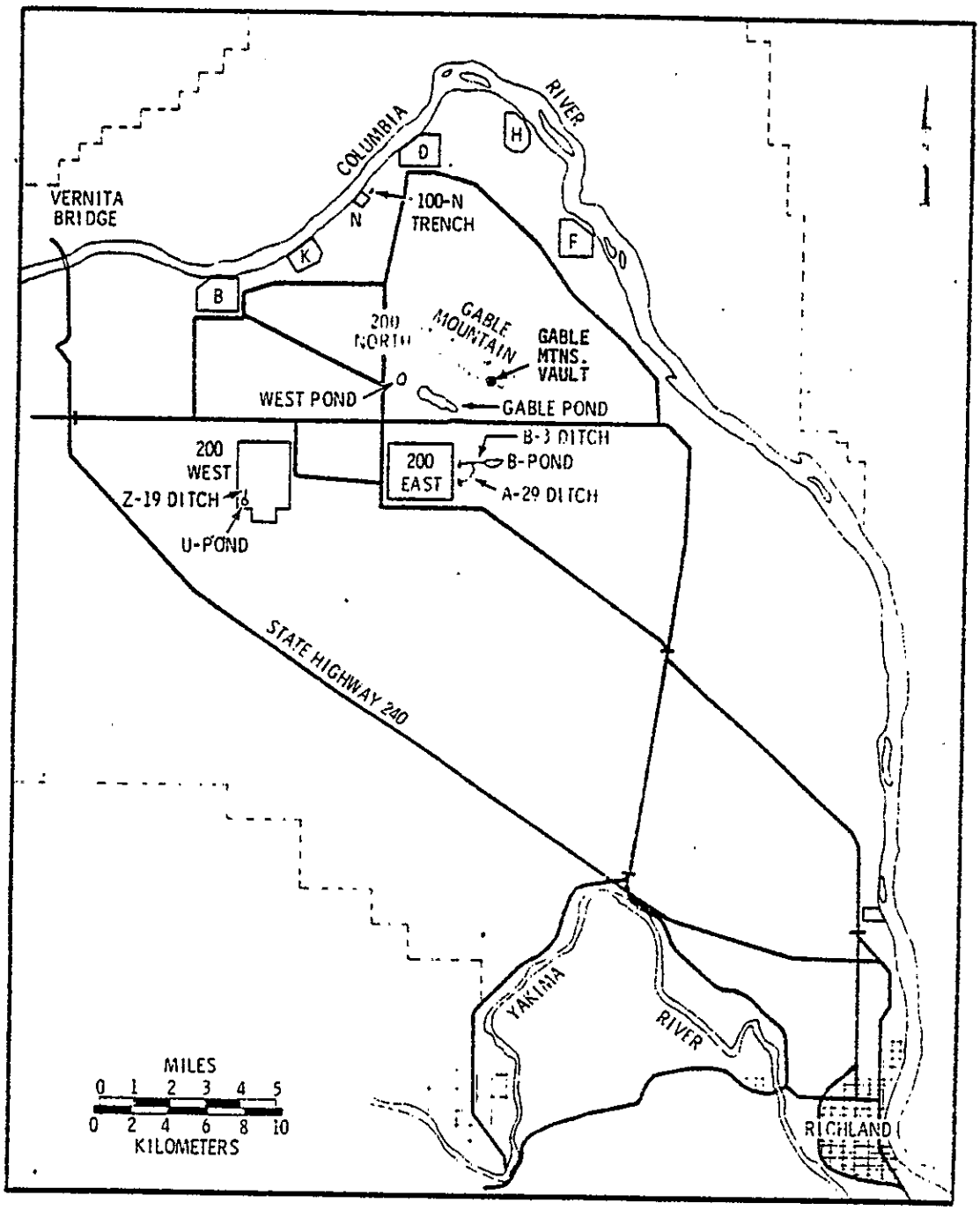


HANFORD SITE MAP

VOLUME III EAST OF 200 EAST AREA QUADRANT (E-200 E)

Waste Disposal Sites and Associated Radiation Zones

Quadrant Boundaries

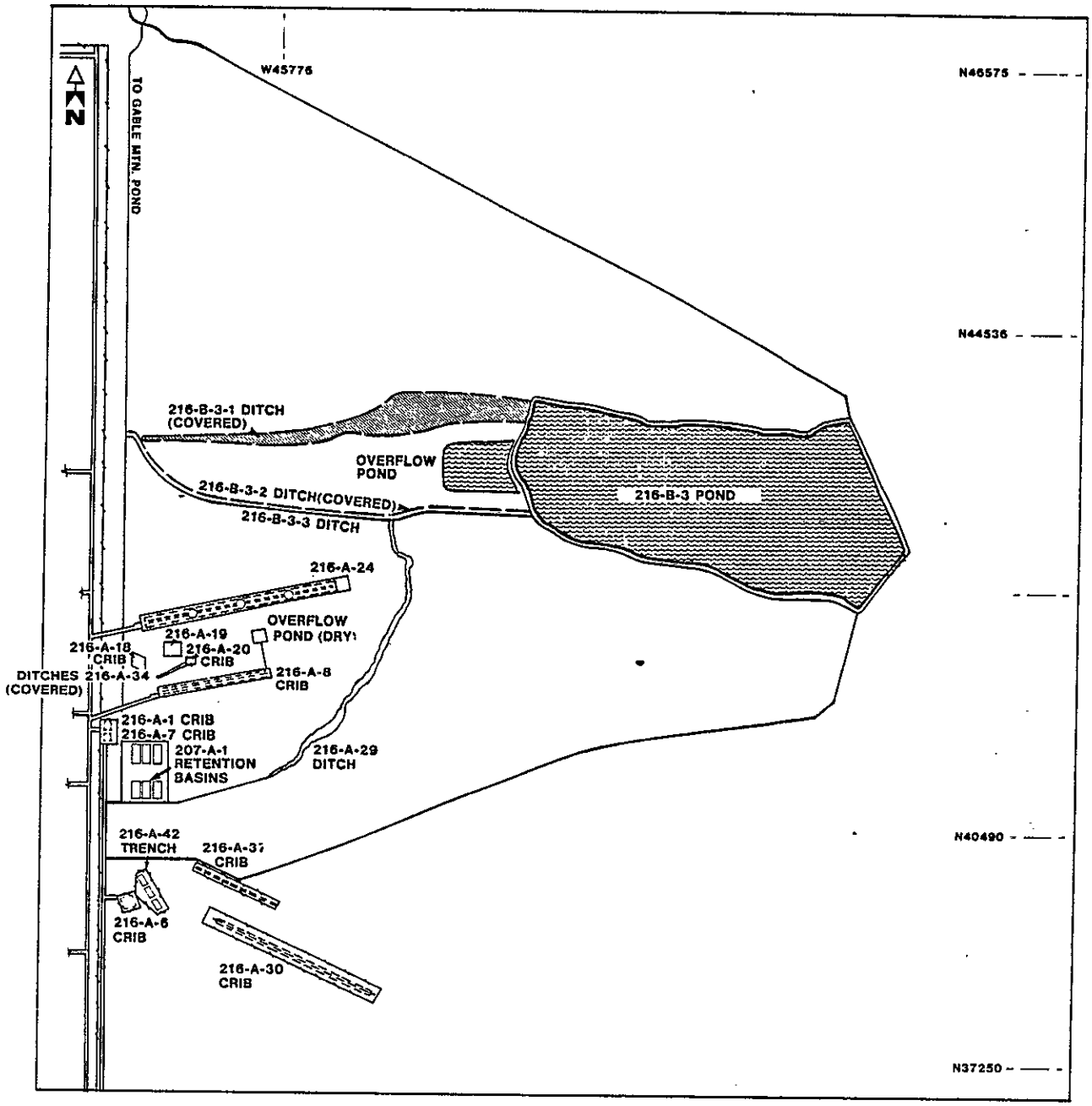
East Boundary	-	East shoreline of 216-B-3 Pond.
South Boundary	-	Highway 4-S from the brow of the East Area hill to the southeast corner of 200 East Area.
West Boundary	-	East fenceline of 200 East Area.
North Boundary	-	Extension of the 200 East Area north fenceline to a point due north of 216-B-3 Pond east shoreline.

See Quadrant maps at the end of this section.

How to read the Index and locate a site:

Example - 216-A-29 Ditch

Site Number	Volume	Quadrant
216-A-29 Ditch	III.	E-200 E


W45776
N46575
N44536
N40490
N37250
TO GABLE MTN. POND
216-B-3-1 DITCH (COVERED)
OVERFLOW POND
216-B-3-2 DITCH(COVERED)
216-B-3-3 DITCH
216-B-3 POND
216-A-24
OVERFLOW POND (DRY)
216-A-19
216-A-18 CRIB
216-A-20 CRIB
DITCHES 216-A-34 (COVERED)
216-A-8 CRIB
216-A-1 CRIB
216-A-7 CRIB
207-A-1 RETENTION BASINS
216-A-29 DITCH
216-A-42 TRENCH
216-A-37 CRIB
216-A-6 CRIB
216-A-30 CRIB

INDEX - VOLUME III OUTSIDE 200 EAST AREA

East Quadrant

Name/Type of Facility	Past Designation	Number
Crib	216-A-1 Cavern 216-A-1 Trench	216-A-1

Location	Service Dates	Status
200 East, Outside-East Quadrant 200 ft East of 241-A Tank Farm, along Canton Ave.	11/55-12/55	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-41330, W-47150 (center)	H-2-56016	Ground	668 ft
		Water Table	404 ft(1973)
		Site Depth	15 ft

Source and Description of Waste

9.84×10^4 liters. Deactivated uranium waste from cold start-up in 202-A.

Description of Facility

One crib, rock structure, 30 ft x 30 ft bottom surface. Deactivation: Overground piping was removed and the crib backfilled when the specific retention capacity was reached.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<0.10	< .1
Beta, Ci	<0.10	< .232
^{90}Sr, Ci	<0.10	$< 5.68 \times 10^{-2}$
^{106}Ru, Ci	<0.10	$< 1.29 \times 10^{-8}$
^{137}Cs, Ci	<0.10	$< 5.89 \times 10^{-2}$
^{60}Co, Ci	<0.10	$< 4.82 \times 10^{-3}$
U, kg	154	1.54×10^{2}

Site Characterization

Well E-25-2 monitors this crib, gamma scintillations well logs show a zone of ground contamination from about 15 ft to 55 ft below ground surface.

Name/Type of Facility	Past Designation	Number
Crib	216-A-6 Cavern	216-A-6

Location	Service Dates	Status
200 East, Outside - East Quandrant 1000 ft East of 202-A Bldg. 250 ft East of Canton Ave.	12/55-1/61 11/65-1/70	Formally Deactivated

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-40042.23, W-46785.00	H-2-44501 shts. 36&	Ground	688 ft
N-39887.14, W-46733.85	H-2-55900 37	Water Table	406 ft (1969)
N-39775.59, W-47050.36	H-2-56015		
N-39929.12, W-47104.50	H-2-56016	Site Depth	19 ft

Source and Description of Waste

3.4×10^9 liters. Steam condensate, equipment disposal tunnel floor drainage, the water filled door drainage, and the slug storage basin overflow waste from 202-A. Low-salt, neutral/basic.

Description of Facility

One crib, rock structure, 100 x 100 ft bottom area. Deactivation: The effluent line to the crib was blanked in Distributor Box No. 1 when the effluent flow-rate exceeded the infiltration capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<36	$< 3.56 \times 10^1$
Beta, g	7.6×10^4	$< 3.93 \times 10^2$
^{90}Sr, Ci	91	5.96×10^1
^{106}Ru, Ci	220	2.57×10^{-2}
^{137}Cs, Ci	210	1.39×10^2
^{60}Co, Ci	1.9	0.48
U, kg	170	1.67×10^2

Site Characterization

Well E25-3 monitors the 216-A-6 crib. The 1959 log reflects the increase in disposal waste activity that occurred in December, 1958, and January-February, 1959. Over half the total radioactivity was discharged in December, 1960, and the increased count rate noted on the 1963 log at 30 ft reflects this disposal.

NOTE: The radiation zone denoting the 216-A-6 crib was enlarged (approximately doubled) to include the contaminated ground surface to the northeast of the crib. Which surface had become contaminated from numerous overflows of the A-6 Crib.

216-A-6 continued

History:

The crib was formally deactivated. Work was completed August 28, 1974. See Attachment for complete details of the deactivation operation and crib history.

No incident of radioactive contamination has been noted at the crib site since deactivation in 1974.

RHO-CD-673

Atlantic Richfield Hanford Company

OUTDOOR RADIATION ZONE DEA AND TRANSFER OF RESPONSIBILITY

DATE August 28, 1974

TO: (MANAGER RADIATION MONITORING SUBSECTION ~~TECHNICAL STANDARDS/NEPA~~) Receiving Section ~~XXXXXXXXXXXXXXX~~
Environmental and Occupational Safety Section B. J. Saueressig

FROM: (MANAGER ORIGINATING SECTION) Tank Farm Management J. A. Teal

REFERENCES

(1) RADIOACTIVE WASTE DISPOSAL GUIDES – PART I, "GROUND DISPOSAL–TERMINATING SITES," ATOMIC ENERGY COMMISSION MANUAL – RL APPENDIX 0510–1, JULY 13, 1967.

(2) HWS–1000, "HANFORD ARCHITECTURAL AND CIVIL STANDARDS, AC–3–20 (JUNE 20,1960), AC–5–2 (OCTOBER 19, 1959), AND AC–5–40 (AUGUST 25, 1960).

3. ARH–220, "RADIATION PROTECTION STANDARDS AND CONTROLS, STANDARD NO, 1," PERSONNEL PROTECTION OPERATION, ~~SEPTEMBER~~ ~~XXXXXXX~~ Aug. 14, 1972

4. ATLANTIC RICHFIELD HANFORD COMPANY OPERATING INSTRUCTION 1.6.5.2, "OUTDOOR RADIATION ZONES" Jan. 26, 1972

I SUMMARY

CONDITIONS FOR DEACTIVATION OF THE 216-A6 Crib

HAVE BEEN SATISFIED AND FUTURE RESPONSIBILITY TRANSFERRED TO ~~XXXXXXXXXXXXXXX~~ Environmental and Occupational Safety Division (E&OS)

APPROVED: APPROVED:

MANAGER ~~XXXXXXXXXXXXXXXXXXXX~~ E&OS DATE MANAGER ORIGINATING SECTION (TF Mgmt) DATE

II RADIATION ZONE RECORD

1. ORIGIN OF MATERIALS INTRODUCED TO THE SITE

Steam condensate from Purex canyon process vessels heating coils and tube bundles, railroad tunnel floor drainage, burial tunnel water filled door drainage, slug storage basin overflow and jetout and drainage from pump pits Nos. 6 and 7.

2. HISTORY:

DATE OF INITIAL USE: November 1955 DATE OF FINAL USE: October 20, 1966

1/31/61 - Crib abandoned when flow exceeded crib capacity and resulted in cave in. Flow was directed to the new 216-A30 crib.

7/64 - Put back in service when west section of 216-A30 crib overflowed. Used in parallel with the 216-A30 crib.

10/20/66 Crib abandoned again and all flow directed to 216-A30 crib. The 216-A6 crib overflowed on several occasions and a trench was dug to connect the overflow to the chemical sewer ditch. The trench was backfilled and the contaminated area East of the 216-A6 crib was bladed and the remaining contaminated area was enclosed along with the area above the 216-A6 crib.

3. ESTIMATE OF RADIONUCLIDE AND CURIE INVENTORY: 4443.0 Ci total Beta; 364.0 Lbs Uranium

	A	B	C
RADIONUCLIDE:	^{90}Sr ^{137}Cs	^{60}Co ^{106}Ru	^{239}Pu
CURIES:	91.0 Ci 211.0Ci	1.86Ci 223.0Ci	35.6 grams

4. RADIATION SURVEY OF THE ZONE

CONDITIONS: (A) ALL ZONE SURFACES TO BE LESS THAN 1 MRAD/HR (B) NO MEASURABLE SURFACE CONTAMINATION

(A) All ground surface dose rates <1 mrem/Hr

(B) The ground surface area directly above the crib was covered with six (6) inches of sand and topped with sheeting of clear 10 mil plastic to act as a plant root barrier. The plastic sheeting was covered with 18 inches of sand and stabilized by four (4) inches of gravel to prevent wind erosion.

9211365

BD–6700–091.1 (7–71) AEC-RL RICHLAND, WASH.

DATE: August 28, 1974

SURVEY RESULTS		DATE OF SURVEY	REMARKS:
A. RADIATION	<1 mrem/hr ~~XXXXXX~~	Jan. 17, 1973	
B. CONTAMINATION	< 300 c/m BETA-GAMMA	Jan. 17, 1973	
	< 500 d/m ALPHA	Jan. 17, 1973	
C. MOST RECENT GROUND WATER SAMPLE RESULTS	_____ µC/ML	_____	

5. DRAWINGS (SHOWING PLOT PLAN, MARKERS, MONITORING WELLS, SIGNS, BARRIERS, COORDINATES, ELEVATION, AND DETAILS OF STEPS TAKEN TO PRECLUDE FUTURE USE): Facilities Change Notice No. 1221 (298) issued.

DRAWINGS H-2 56015, H-2-56016 and H-2-44501 sheets 36 and 37 ATTACHED

III. DEACTIVATION WORK

	DATE		DATE
1. VENT RISERS SEALED OFF BELOW GRADE	November 1972	3. GROUND STABILIZATION (PREVENTION OF EROSION AND TUMBLEWEED GROWTH)	November 1972
2. INLET AND TRANSFER LINES DEACTIVATED.	March 24, 1970	4. OTHER WORK PERFORMED:	

HOW DEACTIVATED: A redwood plug was driven into the A6 inlet line at the A6-A30 Crib diverter box. Concrete was poured over the plugged end of the inlet line.

Plastic barrier and gravel cover over crib was completed July 1972. Marker posts with descriptive medallions were installed per Hanford standard.

IV ZONE IDENTIFICATION

	DATE		DATE
1. PERMANENT MARKERS INSTALLED	1955		
2. FENCE OR CHAIN BARRIER INSTALLED IF ZONE IS SUBJECT TO CAVE – IN.	1955 and 1970	3. RADIATION ZONE SIGNS INSTALLED SO AS TO BE VISIBLE FROM ALL AVENUES OF APPROACH TO THE ZONE.	1955, 1970 & Nov. '72

V REMARKS

The four (4) liquid level risers located in each of the four (4) crib quadrants plus a center of crib riser were cut off about two (2) feet below grade and filled with concrete. All crib deactivation work was completed by year end of 1972.

DISTRIBUTION: 1. MANAGER – ORIGINATING SECTION
2. MANAGER – ~~XXXXXXXXXXXXXX~~ E&OS
3. MANAGER – ~~XXXXXXXXXXXXXX~~
4. MANAGER – ~~XXXXXXXXXXXXXX~~ Development Engineering
5. MANAGER – RADIATION MONITORING
EXTRAS
Operations Technical Support (OTS)

Name/Type of Facility	Past Designation	Number
Crib	216-A-7 Cavern	216-A-7

Location	Service Dates	Status
200 East, Outside - East Quadrant 200 East Area. East of the 241-A Tank Farm across Camden Avenue.	1/56 to 7/59	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-41205, W-47200	H-2-55951 H-2-56016	Ground Water Table Site Depth	785 ft 404 ft(1973) 15 ft

Source and Description of Waste

3.3×10^5 liters. Catch tank over flow waste, sump waste, and sump pit drainage from the 241-A152 Diversion Box. Low-salt, neutral/basic.

Description of Facility

Rock-filled crib, 10 ft x 10 ft bottom dimensions.
Deactivation: effluent piping from the 241-A-152 Diversion Box sump has been blanked off.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	1.0	1.0
Beta, Ci	80	< 7.05
^{90}Sr, Ci	1.0	0.58
^{106}Ru, Ci	30	5.16×10^{-4}
^{137}Cs, Ci	5.0	3.06
^{60}Co, Ci	0.1	5.50×10^{-3}
U, kg	6.8	6.80

Name/Type of Facility	Past Designation	Number
Crib		216-A-8

Location	Service Dates	Status
200 East, Outside-East Quadrant Approximately 650 ft east of the 241-AX Tank Farm.	11/55 - 5/76	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations
N-41612, W-46734 to N-41779, W-45870	H-2-56157 H-2-56158	Ground 654 ft Water Table 404 ft (1973) Site Depth 14 ft

Source and Description of Waste

Service Dates

From	To	
11/55	12/57	Received the condensate from the waste storage tanks in the 241-A and AX Tank Farms.
*12/57	5/58	Received the above effluents and cooling water from the contact condensor in the 241-A-431 Building.
5/58	1/66	Inactive. (Rerouted the cooling water to the 216-A-25 Pond.)
1/66	4/76	Put back in service to receive the condensate from the waste storage tanks in the 241-A and AX Tank Farms after a reevaluation of the radionuclide capacity of the crib.
5/76	-	Inactive.

*Crib approached radionuclide capacity; valved out effluent to crib and rerouted condensate to the new 216-A-24 Crib.

Description of Facility

Crib, 24" SCH20 perforated distribution pipe, placed horizontally 7 ft below grade. The excavation has bottom dimensions at 850 ft x 20 ft, and is 14 ft deep. There is 7 ft (206,000 ft^3) of gravel fill, backfilled over. Slope: 2:1

Crib: 216-A-8 continued

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.0×10^{1}	50.0
Beta, Ci	1.1×10^{4}	1480.0
^{90}Sr, Ci	1.1×10^{2}	69.6
^{106}Ru, Ci	9.9×10^{2}	0.219
^{137}Cs, Ci	1.1×10^{3}	692.0
^{60}Co, Ci	1.8	< 0.187
U, Kg	$<3.7 \times 10^{2}$	368.0

Site Characterization Status

Two test wells near the inlet (west) end of the 216-A-8 Crib indicated ^{137}Cs concentrations less than detection limit (8×10^{-7} µCi/g) below 40 ft prior to 1967. The ^{90}Sr concentrations were less than 3×10^{-4} µCi/g at depths greater than 25 ft in both wells. It was believed that only a few curies of long-lived beta emitters were present in the 25 ft thick zone above the water table as it existed in 1967.

*May have history of overflow to small pond.

(See next page)

216-A-8 continued

Radiation Inspection

February 20, 1979: A radiation survey was made of the ground surface area of the 216-A-8 Crib. One plant of Rabbit Brush growing over the centerline of the crib, and about 3/5 of the length of the crib from the head end, was found to be internally radioactive to a maximum of 6000 c/m beta-gamma activity as read on a mica window GM survey instrument held at the branch ends of the plant. Radioactivity was also found to be coming from residue leaf mold from the ground surface around the base of the plant.

Also, all pipe risers coming from the interior of the crib were found to be very open to the atmosphere and to be reading from 600 to 6000 c/m beta-gamma activity at contact with the pipe openings.

* Note: There was no radioactivity found on the bottom of the dry overflow pond, 2/20/79.

RHO-CD-673

SWP ☐ RWP ☐ NO _____

RADIATION SURVEY

SURVEY NUMBER T 26371

TIME JOB STARTED | TOTAL TIME | RESPIRATORY PROTECTION WORN: N R A C FA

LOCATION: 200 W | INSTRUMENT(S) USED: GM-PAM

JOB DESCRIPTION: Routine Portion Radiation Survey

ITEM OR LOCATION AND REMARKS	* DOSE RATE	WO	WC	DIST.	NEUTRON	DIST	c/m	d/m
Observed on 216-A-3 Crib								
one large rabbit brush plant near center line of crib, about 3/5 the length of crib from head end 600 c/m								
All risers are open and are reading from 600 to 600 c/m								

☐ OVER

* DOSE RATE - WHOLE BODY, NORMALIZED TO WHOLE BODY OR BODY EQUIVALENT

SIGNED: R. M. Rustenstick

SHIFTS: XYZ, D, C, B, A, DAYS

DAY: 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

TIME: 12-8, 8-4, 4-12

FUNCTIONS: BURIAL, CONTROL PROGRAM, DECONT, FOLLOW-UP, INSP, LAB, MAINT, PERSONNEL SURVEYS, PROCESS WORK, RAIL MOVEMENT, RELEASE, SAMPLING, ON SITE SHIPMENT, OFF SITE SHIPMENT, VEHICLES, CONTAM CLOTHES, CONTAM SKIN, MONTHLY REPORT, NASAL SM. AND IRRIG, REPORTED TO RPO, RADIATION OCCURRENCE, RZ INJURY, B PLANT

REPORTS

PLANTS: PUREX, S, T, 242-S, Z, TANK FARMS, 200 GENERAL

OPERATIONS: CONST, LAB., MAINT, PROCESSING, RADIATION MONITORING, RECLAMATION, SP SER DECON., UO_3, ENCAP., OTHER

YEAR: 1977, 1978, 1979 X, 1980

MONTH: JAN, FEB X, MARCH, APRIL, MAY, JUNE, JULY, AUG, SEPT, OCT, NOV, DEC

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Crib	216-A-18 Excavation 216-A-18 Grave 216-A-18 Sump	216-A-18

Location	Service Dates	Status
200 East, Outside-East Quadrant East of 241-AZ Tank Farm	11/55-12/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-41860, W-47000	H-2-56119 H-2-56521 H-2-56977 H-2-55900	Ground Water Table Site Depth	656 ft 405 ft (1973) 15 ft

Source and Description of Waste

4.9×10^5 liters. Depleted uranium waste from cold start-up in 202-A.

Description of Facility

One crib, 80 ft x 80 ft bottom surface, excavation only (crib never built).
Deactivation: Overground piping removed and the crib backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<0.10	< .10
Beta, Ci	<0.10	< .236
^{90}Sr, Ci	<0.10	< 5.68×10^{-2}
^{106}Ru, Ci	<0.10	< 1.29×10^{-8}
^{137}Cs, Ci	<0.10	< 5.89×10^{-2}
^{60}Co, Ci	<0.10	< 4.82×10^{-3}
U, kg	1.4×10^3	1410.0

Name/Type of Facility	Past Designation	Number
Crib	216-A-19 Test Hole 216-A-19 Grave 216-A-19 Sump	216-A-19

Location	Service Dates	Status
200 East, Outside-East Quadrant 750 ft East of the 241-AX Tank Farm, 500 ft East of Canton Ave.	11/55-1/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-41900, W-46680	H-2-56521	Ground	652 ft
		Water Table	405 ft(1973)
		Site Depth	15 ft

Source and Description of Waste

1.1×10^8 liters. 241-A-431 contact condenser cooling water, via the 216-A-34 Ditch; depleted uranium waste from cold start-up run in 202-A.

Description of Facility

One crib, excavation, 25 ft x 25 ft bottom surface. Deactivation: Overground piping removed and the crib backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<0.10	< 0.10
Beta, Ci	1	< 0.232
^{90}Sr, Ci	<0.10	$< 5.68 \times 10^{-2}$
^{106}Ru, Ci	<0.10	$< 1.29 \times 10^{-8}$
^{137}Cs, Ci	<0.10	$< 5.89 \times 10^{-2}$
^{60}Co, Ci	<0.10	$< 4.82 \times 10^{-3}$
U, kg	3.9×10^4	3.90×10^4

Name/Type of Facility	Past Designation	Number
Crib	216-A-20 Test Hole 216-A-20 Grave 216-A-20 Sump	216-A-20

Location	Service Dates	Status
Outside-200 East, East Quadrant 800 ft East of 241-AX Tank Farm, 600 ft East of Canton Ave. Near 216-A-19 and A-8	11/55-1/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-41875, W-46540	H-2-56521	Ground	652 ft
		Water Table	405 ft
		Site Depth	15 ft

Source and Description of Waste

9.6×10^5 liters. 241-A-431 contact condenser cooling water via the 216-A-34 Ditch; depleted uranium waste from 202-A cold start-up.

Description of Facility

One crib (hole), 25 ft x 25 ft bottom surface. Deactivation: Overground piping removed, hole backfilled when the specific retention capacity was reached.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<0.10	< 0.10
Beta, Ci	1	< 0.232
^{90}Sr, Ci	<0.10	< 5.68×10^{-2}
^{106}Ru, Ci	<0.10	< 1.29×10^{-8}
^{137}Cs, Ci	<0.10	< 5.89×10^{-2}
^{60}Co, Ci	<0.10	< 4.82×10^{-3}
U, kg	400	404.0

Name/Type of Facility	Past Designation	Number
Crib		216-A-24

Location	Service Dates	Status
200 East, Outside - East Quadrant 500 ft. east of the 241-AZ Tank Farm	5/58-1/66	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-42206, W-46854 to N-42494, W-45328	H-2-56977 H-2-56978	Ground Water Table Site Depth	646 ft 406 ft(1973) ~15 ft

Source and Description of Waste

8.2 x 10^8 liters. Condensate from waste storage tanks in 241-A and 241-AX Tank Farms. Low-salt, neutral/basic.

Description of Facility

One crib, rock structure, 1400 ft x 20 ft bottom surface area. Deactivation: The effluent pipeline to the crib was valved out.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<5	< 5.06
Beta, Ci	4980	<735.0
^{90}Sr, Ci	39	24.8
^{106}Ru, Ci	408	6.19×10^{-3}
^{137}Cs, Ci	549	355.0
^{60}Co, Ci	0.7	5.88×10^{-2}
U, kg	50	50.1

Site Characterization Status

Well E-26-5 monitors the west end of the 216-A-24 Crib. Most of the waste (3900 curies) was discharged in 1958 and 1959. After December 1959, waste volume and activity sent to the A-24 Crib was greatly reduced. The scintillation well log of April 28, 1958, shows no ground contamination at the site prior to disposal. On June 17, 1958, about one month after disposal started, gross contamination in the ground was present to a depth of 130 feet. On June 3, 1959, about one year after disposal started, the entire soil column was contaminated.

216-A-24 continued

Site Characterization Status cont.

The 1963 log reflects the decay of radionuclides due to reduction in the amount of activity disposed to this site.

Well E26-4A was drilled to a depth of 245 feet at the inlet end of the 216-A-24 Crib in 1966 to determine the distribution of radionuclides below this site. Cesium-137 was found at low levels throughout the soil column. Soil samples near the water table, 200 feet below ground surface, contained about 2×10^{-6} µCi ^{137}Cs per gram. Strontium-90 concentrations were down to 1×10^{-4} µCi/g at 45 ft. below ground surface. The highest ^{137}Cs concentration (0.3 µCi/g) and the highest ^{90}Sr concentration occurred at 19 ft. below ground surface. Water samples from one monitoring well adjacent to this crib showed ^{90}Sr concentration occurred at 19 ft below ground surface. Water samples from one monitoring well adjacent to this crib showed ^{90}Sr concentrations of about 1×10^{-8} µCi/cc. Only a few curies of long-lived radioisotopes were believed to be in the 25-ft zone above the water table that existed in 1967.

History

Re: BNWL - 1948
Radioactivity Associated with Biota and Soils of the 216-A-24 Crib
Klepper-Rogers-Hedlund-Schreckhise

EXECUTIVE SUMMARY

The 216-A-24 Crib was build in 1957 and was used from 1958 to 1966 to receive condensate from the 241-A and 241-AX Tank Farms. As of December, 1974, the Crib still retained an estimated 385 Ci of ^{137}Cs and 27 Ci of ^{90}Sr. In 1974, rabbitbrush plants (Chrysothamnus nauseosus) growing on the Crib were found to contain radioactive materials.

Highest levels of activity and densest stands of rabbitbrush plants were in the center of the second section of the Crib where a Geiger-Muller count rate meter showed surface exposure rates of certain plants to be as high as 125 times background. Of the 519 shrubs on the second section, 364 were at background, 62 were up to 10 times background, and 93 were over 10 times background. Contaminated shrubs were restricted to the center of the Crib. All shrubs more than 6 meters away from the centerline were at background levels. The shrubs were, on the average, 9.4 years old (range 6-12 years).

The radionuclide involved was primarily ^{137}Cs. Concentrations of ^{137}Cs in leaf tissues were approximately 1500 times the concentrations of ^{90}Sr. Other fission products were observed, but the levels were at or near detection limits. Soil excavations showed that rabbitbrush plants were sufficiently deep-rooted to reach the gravel drainfield which is at the 8-foot depth in the shallow end of the Crib section. The shrubs appeared to absorb ^{137}Cs and trace amounts of other fission products from within or below the gravel layers.

216-A-24 continued

EXECUTIVE SUMMARY cont.

A somewhat surprising finding was that gravel appeared to hold significant amounts of ^{137}Cs. Soil above the gravel layers was not contaminated although there were detectable levels of ^{137}Cs in the rabbitbrush roots which grew through that soil. Cesium-137 was detectable in the upper cm of soil and in the litter, especially beneath canopies of plants with high levels of ^{137}Cs in their leaves. However, at the 15 cm depth, ^{137}Cs was not detectable in the soil. Consequently, deep excavation will not be required for decontamination.

Some animal samples collected on the Crib contained ^{137}Cs. Those insect species associated with a rabbitbrush shrub containing ^{137}Cs and its litter showed higher levels of ^{137}Cs than other wider-ranging species caught in pitfall traps and by hand. Two out of seven pocket mice contained detectable amounts of ^{137}Cs with 70% of the total body burden in the muscle and skeleton.

Radiation Monitoring was informed on June 13, 1979 at about 10:00 a.m. that moisture was being encountered in the excavation east of the 200 East Area perimeter fence where fill dirt was being obtained for the 241-AN Tank Farm. Follow-up surveys revealed beta contamination to a maximum of 8,000 c/m in the moisture, on the earthmoving equipment, and in the newly hauled-in soil around the new 241-AN Tanks.

The reference excavation is located adjacent to and north of the 216-A-24 Crib. It was dug sloping from 5 to 20 feet deep, 430 feet long, and an average of 110 feet wide. The source of the contamination was determined to be moisture from the A-24 Crib that had migrated laterally over the surface of a four-inch crust of "hardpan". The "hardpan" was approximately 15 feet below normal ground surface.

Several hundred yards of contaminated soil were taken from the 241-AN Tank Farm and returned to the excavation. Plans are to completely refill the excavation with a clean soil cover. The area is presently a large radiation area on the north side of the 216-A-24 Crib.

CHEMICAL PROCESSING DIVISION

RADIATION OCCURRENCE

TO: MN Raile

This is associated with file 216-A-24 trench radioactive site

RADIATION OCCURRENCE FACTS

DATE: 6/13/79 | TIME: 1030 am

LOCATION: 241- AN Tank Farms

RADIATION OCCURRENCE TYPE: 3-B

Loss of control of contamination from radiation zones.

CAUSE CODE: 1-A, 2-C

Procedures and methods were inadequate.
Procedures and methods were not followed.

COMPLETE DESCRIPTION AND CAUSE

DESCRIPTION

Radiation Monitoring was informed on June 13, 1979 at about 10:00 a.m. that mositure was being encountered in the excavation east of the 200-East Area perimeter fence where fill dirt was being obtained for the 241-AN Tank Farm. Follow-up surveys revealed beta contamination to a maximum of 8,000 c/m in the moisture, on the earth-moving equipment, and in the newly hauled-in soil around the new 241-AN Tanks. Surveys of personnel revealed no skin or clothing contamination.

CAUSE

Soil was not being removed from the area east of the 200-East perimeter fence which had been designated for the excavation.

CC:
EN Dodd, Jr.
RJ Gimera
WF Heine
LL Johnson
JV Mohatt
GC Owens
BJ Saueressig
RM Supervisors

ACTION TAKEN
1. Radiological status surveys were made of affected area.
2. The area was zoned off and posted.
3. Decontaminated and released the earthmoving equipment.
4. Involved personnel were given nasal smears and whole-body counts. All of which were negative.
5. Air sampling equipment was placed in strategic locations.
6. This incident further addressed in JA Jones Occurrence Report 79-19

INVESTIGATED BY: WR Hodges/GW Givan/RM Ybarra

DATE OF INVESTIGATION: 6/13/79

EXPOSED EMPLOYEES

None

A-6840-002 (3 -66)

Name/Type of Facility	Past Designation	Number
Swamp	Gable Mountain Swamp 216-A-25 Swamp	216-A-25

Location	Service Dates	Status
Outside-200 East, North Quadrant Approximately 1 mile south of the west end of Gable Mountain. In the bottom of the old coulee between Gable Mtn. and the 200 East Area.	12/57- Present	Active

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-55632, W-51350 to N-54763, W-52052 to N-50962, W-47349 to N-51830, W-46647	H-2-3325 H-2-3330 H-2-3332 H-2-66018	Ground Water Table Site Depth	438 ft 403 ft 0

Source and Description of Waste

1.86×10^{11} liters. Cooling water from surface condenser in 241-A-131; process cooling water from 202-A; cooling water from 244-AR Vault. Received a single unplanned release of 10,000 Ci in June, 1964.

Description of Facility

Swamp. 71 Acres.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	4.2×10^2	< 426.0
Beta, Ci	2.3×10^5	1440.0
^{90}Sr, Ci	4.8×10^2	346.0
^{106}Ru, Ci	7.4×10^2	< .759
^{137}Cs, Ci	3.6×10^2	266.0
^{60}Co, Ci	$<4.4 \times 10^1$	< 11.7
U, kg	$<6.4 \times 10^2$	< 878.0
^{233}U, g	$<4.6 \times 10^2$	< 459.0

History:

From 12/57 the pond received the process cooling water from the 202-A Building. In May 1958 the cooling water from the contact condenser in the 241-A-431 Bldg. was added to the stream. In November 1967 the waste water from the 284-E Powerhouse was also sent to the 216-A-25 Pond.

216-A-25 continued

History:

On June 12, 1964, cooling water from the cooling coil of a process waste inventory tank (F-15) in the Purex Plant developed a leak and discharged highly radioactive contaminated waste water into the streams entering the 216-A-25 (Gable Mtn. Pond) and the 216-B-3 Pond.

At that time, 3/4 of the stream went to the Gable Mountain Pond and 1/4 to the B Pond. High radiation levels were immediately detected in both of these facilities and also the 216-B-3-1 Ditch flowing into the B-Pond.

See attachments for a complete description of the June 12, Purex incident.

A study by Battelle environmental personnel, as reported in document BNWL-2000; Part 2, shows the radioactive status of the Gable Mountain Pond for the year 1974 to be as follows:

Dose rates taken at the interface of the pond bottom sediments and the water ranged from .075 mR/hr to a maximum of 9.5 mR/hr.

The predominant activity (approximately 90%) is cesium-137, which ranges from 0.37 to 65 nanocuries per gram of dry weight sample material.

Greater than 90% of the cesium is resting within the top 2 inches of the sediment and soil at the bottom of the pond.

Low level ground contamination to 1500 c/m beta-gamma activity remains near the shoreline on the northwest corner of the Gable Mountain Pond.

RHO-CD-673

CHEMICAL PROCESSING DIVISION
RADIATION OCCURRENCE

TO:
R. W. McCullugh, Manager
Processing
Purex Operation

RADIATION OCCURRENCE FACTS

DATE: 6-12-64 | TIME: 12-8

LOCATION: Purex Cooling Water Swamp

RADIATION OCCURRENCE TYPE: 3-C
Uncontrolled radiation or contamination inside a Radiation Zone

CAUSE CODE: 1-B
Failure of Equipment

COMPLETE DESCRIPTION AND CAUSE

Fission products contamination was released to the B- and Gable Mountain cooling water swamps from a leaking cooling coil in a 202-A process waste tank (F-15).

Observations

1. Cooling water (usually slightly contaminated) from Purex process vessels is routed to the swamps via a common line from 202-A. A diverter station divides the flow between B Swamp and Gable Mountain Swamp.

2. A cooling coil on the F-15 Tank developed a leak on 6-11-64. At 0100 on 6-12-64 the cooling water was turned off and the coil was air-purged until the cooling water was restored at 0130. At 0200 the cooling water was again turned off and restored at 0750.

3. The cooling water in the coil provided sufficient pressure to prevent the highly contaminated waste solution from leaking from the tank into the coil. However, this pressurization was apparently not maintained during the air purges and the contaminated liquid which leaked into the coil was discharged to the swamps when the cooling water was restored to the coil. A survey at the 201-A Tank (which received cooling water discharged from 202-A) after the 0130 restoration did not disclose any unusual activities in the water.

4. The following radiation levels were detected during surveys on 6-12-64:

B Swamp

On ditch bank over inlet	2 R/hr. at 8'
At edge of inlet flume	5 R/hr. at 5'
	7 R/hr. at 2"
	50 rads/hr. at 2" (on algae)
Maximum along road parallel to swamp (east-west)	150 mR/hr.

(Continued)

C:
WM Harty-GEC
SG Smolen
RW Harvey (2)
RM File

ACTION TAKEN

1. Appropriate radiation surveys were made.
2. Roads to involved areas were barricaded.
3. Appropriate contacts were made to RPO-HL.
4. The cooling water discharge jumper from the coil to the building discharge header was disconnected.

INVESTIGATED BY: G. E. Cunningham

DATE OF INVESTIGATION: 6-12-64 thru 6-16-64

EXPOSED EMPLOYEES

None

8840-002 (3 - ' - 1

9 2 1 2 3 6 3

B Swamp (Continued)

Along ditch bank (several locations)	2.5 R/hr. at 2" 3.2 R/hr. at 2" 600 MR/hr. at 2"
Along shore of swamp	3000 c/m

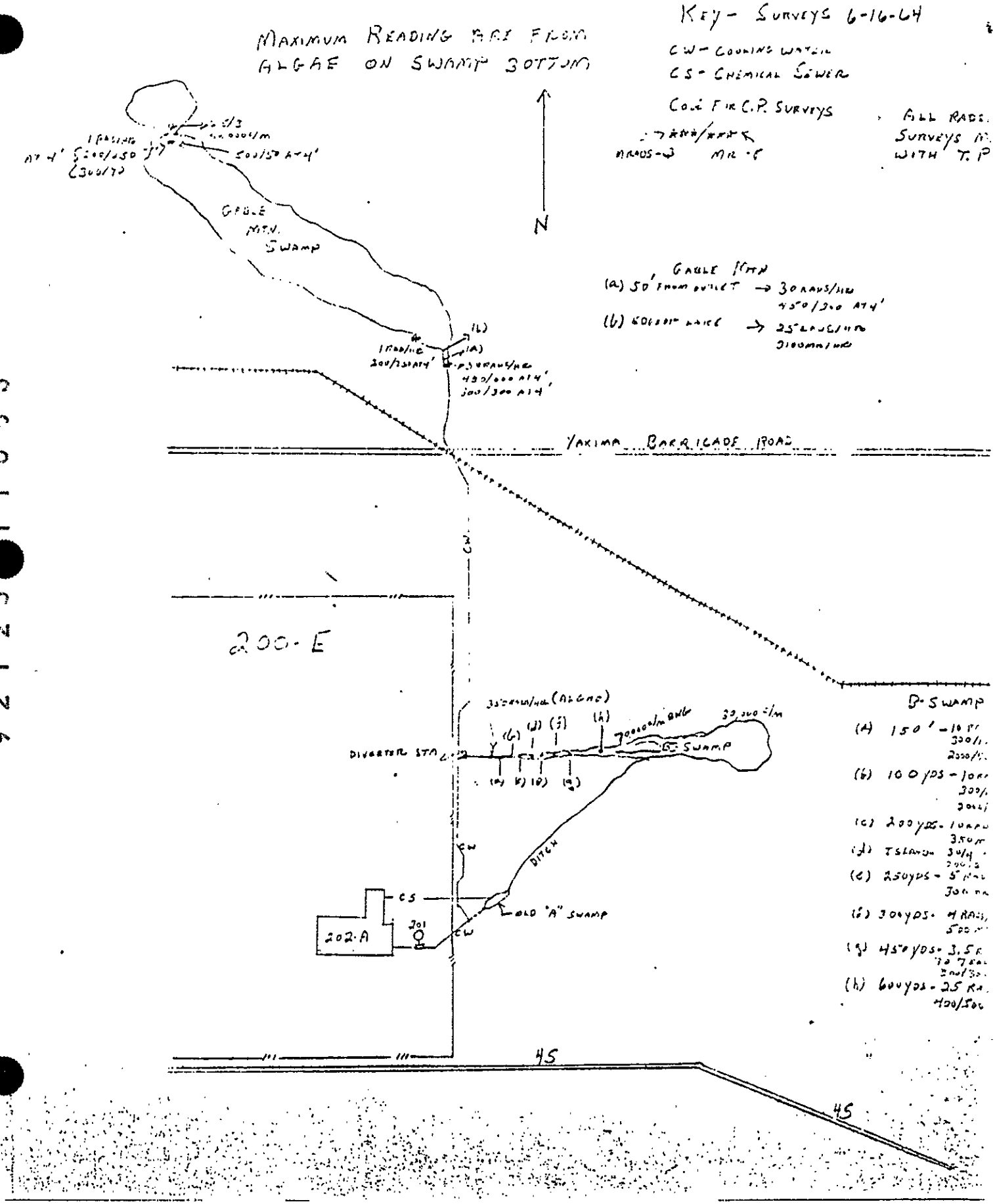
Gable Mountain Swamp

Over inlet	15 to 22 rads/hr. at 2" (probably algae)
Edge of inlet	500 mR/hr. at 2"
Along south shore	500 mR/hr. at 2"
Far end of swamp	Nothing above normal background.

Station surveys made on 6-16-64 are shown on the attached drawing.

Observations

5. Affected areas were barricaded to prevent inadvertent entry of personnel.
6. Caustic was added to the swamps via the cooling water line to precipitate the contamination.
7. Appropriate RPO-HL groups were notified and a study group of HL and CPD personnel has been formed to evaluate the problem.
8. No unplanned exposure of personnel was involved.
9. An engineering study has been initiated leading to improved equipment design which will preclude tank outleakage to coils.



RHO-CD-673

RADIATION CONTROL OF ACCIDENTALLY CONTAMINATED SEEPAGE PONDS

by

G. E. Backman
Chemical Processing Department
General Electric Company
Richland, Washington

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Richland, Washington

June 3, 1965

RL-SA-15

RADIATION CONTROL OF ACCIDENTALLY CONTAMINATED SEEPAGE PONDS

INTRODUCTION

The Chemical Processing Department is located in approximately the center of a 600 square mile reservation in south central Washington state controlled by the Atomic Energy Commission. There are several major production facilities within the department. These facilities receive irradiated fuel elements from which plutonium, uranium and occasionally other radionuclides are recovered in a relatively pure state. Large quantities of process cooling water pass through the plants on a single pass basis and are discharged to low depressions in the surrounding area, where permanent ponds having volumes on the order of tens of millions of gallons are formed. The cooling water is normally uncontaminated with radioactive materials. However, the potential for contamination does exist, should process equipment fail or operating errors occur. During June of 1964, a failure of the cooling coils in one of the process vessels occurred and an unusual contamination condition resulted in two of the ponds associated with one of the major production facilities.

DESCRIPTION OF THE INCIDENT

On June 11, 1964, the cooling coil of a process waste inventory tank (F-15) in the Purex Plant apparently developed a leak since the volume in the tank increased when no streams were knowingly being added to the tank. To verify the existence of a leak, the cooling water supply was cut off and an air purge substituted. The cooling water flow was later

restored as part of the leak test and for temperature control. It was later surmised that during the period when the air purge was conducted, liquid from the tank seeped into the cooling coil. During the early morning on June 12, the cooling water was restored which flushed the material that had seeped into the coils into the cooling water ponds. Shortly after, the cooling water discharge line from this waste tank was disconnected to prevent additional waste from being discharged to these ponds. Radiation surveys were made at the two pond sites. Initial surveys showed gamma radiation levels as high as 5 R/hr eight feet from the pond inlets. Further surveys showed that algae had concentrated the radioactive materials and radiation levels of 7 to 50 rads per hour could be detected over the areas of concentrated algae growth.

One of the ponds ("B" Swamp) has been in service almost since plant start up. It consists of a narrow ditch about a mile long ending in a relatively shallow, open pond (approximate volume of ten million gallons). Roughly one-fourth of the cooling water flow was being discharged to this pond. Algae and other plant growth within the long ditch was substantial and actually served as an excellent filter, removing most of the radioactive material rather than allowing it to be discharged into the open pond, itself. The other pond (Gable Mountain Swamp) has only a short ditch and then opens into a reasonably large expanse of water (approximate volume of fifty million gallons). The remaining three-fourths of the cooling water flow was discharged into this pond. There was only a small amount of algae growth within the trench itself and the radioactive materials that were discharged, were dispersed almost uniformly through the entire liquid volume.

IMMEDIATE ACTION TAKEN

The radiation surveys indicated general high radiation levels and efforts were immediately directed toward preventing any undue personnel exposure. All roadways approaching the ponds were barricaded and posted with appropriate radiation signs. The plant patrol operation was instructed to allow no unauthorized entry beyond these barricades. Water and mud samples were procured from both ponds and sent to the analytical laboratories for analysis. Efforts were made to drive off water fowl that were present in small numbers on both ponds. These efforts were relatively unsuccessful. The fowl appeared to be residents of these areas and only moved to another location on the ponds when attempts were made to frighten them away.

These ponds were known to be frequented by migratory water fowl during certain periods of the year. Shortly after the incident, members of the Biology Department, now with the Battelle Northwest Laboratories, but then a part of General Electric Company, were counsulted for their opinion about the water fowl problem. They indicated that in all likelihood all water fowl present were residents rather than migrants, and that it was unlikely that they would leave the project. They also indicated that it would be at least six to eight weeks before any migratory fowl would be expected.

DISCUSSION OF THE INCIDENT

The process waste inventory tank in which the coil leak occurred is used for temporary storage of concentrated fission product waste. The waste is sampled at this point for inventory purposes and to determine the quantity of chemical reagents needed for neutralization. The content of this tank is transferred to another tank for neutralization and is then

normally sent to underground storage tanks. The concentration of radioactive materials is sufficiently high to cause these underground tanks content to boil. Estimates were made of the amount of activity that escaped to the ponds by determining the radioactive concentration in the solution in the waste tank and estimating the amount of solution that could have seeped into the cooling coils. On the order of 10,000 curies of fission products evidently escaped to the ponds. The following table gives a rough estimate of the percentage of the various radionuclides that were present in any significant concentrations.

TABLE I

RADIONUCLIDE	PERCENT OF TOTAL ACTIVITY	RADIONUCLIDE	PERCENT OF TOTAL ACTIVITY
Sr-89	9.5	$_1$Te-129	0.21
Sr-90	0.4	$_2$Te-129	0.21
Y-90	0.4	Cs-137	0.33
$_2$Y-91	11.5	Ba-137	0.33
Zr-95	14.8	Ba-140	0.28
$_1$Nb-95	0.3	La-140	0.33
$_2$Nb-95	23.2	Ce-141	4.7
Ru-103	5.6	Pr-143	0.4
Rh-103	5.6	Ce-144	9.3
Ru-106	0.75	Pr-144	9.3
Rh-106	0.75	Pm-147	1.35

After the immediate protective action was completed, a Task Force, consisting of operations management personnel, process engineers, a senior chemist, a geologist-hydrologist, a waste disposal engineer, a biologist, and health physicists, was formed to determine further courses of action. The situation was, as best the Task Force could determine, relatively stable and it appeared that there was a reasonable amount of time available for conducting various studies that might aid in suggesting a practical course of action. Several

different types of investigation were conducted on ways to return the ponds to an acceptable status. Each investigation will be discussed as a separate entity, however, these investigations were frequently being conducted concurrently.

It was first recommended by the Task Force that efforts to reduce the high radiation levels should begin as soon as practical so that the potential for personnel exposure would be removed. The first course of action was, therefore, to excavate new trenches into both ponds and to back-fill the old ones. This action was completed toward the end of July, 1965, and as a result surveillance of the area by patrol was no longer required. During this period, operations personnel were successful in keeping the liquid levels of both swamps to nearly the same levels that existed at the time of the incident. The contaminated area was, therefore, not enlarged nor were already contaminated areas allowed to dry out so that the wind could cause further contamination spread.

Shortly after the incident some of the resident water fowl were periodically harvested to determine the amount of external contamination and internal deposition. Tables II and III indicate the results of this program.

TABLE II

WATER FOWL EXTERNAL CONTAMINATION

TYPE OF FOWL	DATE	LOCATION	RADIATION MEASUREMENT (CP Meter Scale Reading)
Teal	6/22/64	Gable Mountain Swamp	100 mrads/hr
Coot	6/22/64	Gable Mountain Swamp	60 mrads/hr
Mallard	6/22/64	Gable Mountain Swamp	40 mrads/hr
Coot	6/22/64	Gable Mountain Swamp	100 mrads/hr

TYPE OF FOWL	DATE	LOCATION	RADIATION MEASUREMENT (GP Meter Scale Reading)
Coot	6/22/64	Gable Mountain Swamp	50 mrads/hr
Coot	6/23/64	Gable Mountain Swamp	25 mrads/hr
Coot	6/23/64	Gable Mountain Swamp	35 mrads/hr
Coot	6/23/64	Gable Mountain Swamp	60 mrads/hr
Coot	6/23/64	Gable Mountain Swamp	15 mrads/hr
Coot	6/23/64	Gable Mountain Swamp	10 mrads/hr
Goose	6/24/64	Redox Swamp*	Bkg (GM Meter)
Coot (3)	6/24/64	Redox Swamp	Bkg (GM Meter)
Mallard	6/24/64	"Y" Swamp*	Bkg (GM Meter)
Ruddy Duck	6/24/64	"Y" Swamp	Bkg (GM Meter)
Teal (5)	6/24/64	"Y" Swamp	Bkg (GM Meter)
Coot	6/29/64	Gable Mountain Swamp	25 mrads/hr
Shoveler	6/29/64	Gable Mountain Swamp	15 mrads/hr
Coot (5)	6/30/64	Gable Mountain Swamp	20 mrads/hr
Mallard	6/30/64	Gable Mountain Swamp	30 mrads/hr
Teal	6/30/64	Gable Mountain Swamp	20 mrads/hr
Coot (3)	7/1/64	Gable Mountain Swamp	35 mrads/hr
Ruddy Duck	7/1/64	Gable Mountain Swamp	30 mrads/hr
Shoveler	7/1/64	Gable Mountain Swamp	35 mrads/hr
Mallard (2)	7/8/64	Honey Hill**	30,000 c/m (GM Meter)
Pintail	7/8/64	Honey Hill	2,000 c/m (GM Meter)
Teal	7/8/64	Honey Hill	20,000 c/m (GM Meter)
Teal	7/8/64	Honey Hill	4,500 c/m (GM Meter)
Teal	7/8/64	Honey Hill	2,000 c/m (GM Meter)
Teal	7/15/64	Honey Hill	10,000 c/m (GM Meter)
Mallard	7/15/64	Honey Hill	400 c/m (GM Meter)
Pintail	7/15/64	Honey Hill	3,000 c/m (GM Meter)
Teal	7/15/64	Honey Hill	80,000 c/m (GM Meter)
Mallard	7/15/64	Honey Hill	1,000 c/m (GM Meter)
Mallard	7/15/64	Honey Hill	5,000 c/m (GM Meter)
Teal	7/15/64	Honey Hill	10,000 c/m (GM Meter)
Domestic	9/29/64	Gable Mountain Swamp	7,000 c/m (GM Meter)
Domestic	9/29/64	Gable Mountain Swamp	300 c/m (GM Meter)
Scaup (8)	11/3/64	Gable Mountain Swamp	900 c/m (GM Meter)
Mallard (3)	11/3/64	Gable Mountain Swamp	3,000 c/m (GM Meter)
Pintail	11/3/64	Gable Mountain Swamp	2,500 c/m (GM Meter)
Teal (2)	11/3/64	Gable Mountain Swamp	500 c/m (GM Meter)
Coot (5)	11/3/64	Gable Mountain Swamp	5,000 c/m (GM Meter)

* Swamps associate with other chemical processing facilities ~6 miles from the contaminated swamp where the incident occurred.

** A small pond approximately one mile from Gable Mountain Swamp.

TABLE III

WILD FOWL INTERNAL CONTAMINATION

TYPE OF FOWL	DATE	LOCATION	pCi/gm Cs-137 CONTENT OF MUSCLE	pCi/gm Sr - Total CONTENT OF MUSCLE
Coot	6/29/64	Gable Mountain Swamp	36,000	120
Shoveler	6/29/64	Gable Mountain Swamp	18[illegible]	NA
Teal	6/30/64	Gable Mountain Swamp	47,000	150
Mallard	6/30/64	Gable Mountain Swamp	17,000	450
Coot	6/30/64	Gable Mountain Swamp	74,000	370
Coot	6/30/64	Gable Mountain Swamp	100,000	120
Coot	6/30/64	Gable Mountain Swamp	5[illegible]	NA
Coot	6/30/64	Gable Mountain Swamp	52,000	NA
Coot	6/30/64	Gable Mountain Swamp	58,000	NA
Mallard	7/1/64	Gable Mountain Swamp	69,000	NA
Shoveler	7/1/64	Gable Mountain Swamp	120,000	NA
Coot	7/1/64	Gable Mountain Swamp	26,000	NA
Coot	7/1/64	Gable Mountain Swamp	73[illegible]	NA
Coot	7/1/64	Gable Mountain Swamp	67,000	160
Teal	7/2/64	Gable Mountain Swamp	38,000	200
Coot	7/2/64	Gable Mountain Swamp	91,000	110
Coot	7/2/64	Gable Mountain Swamp	89,000	270
Coot	7/2/64	Gable Mountain Swamp	92,000	NA
Coot	7/2/64	Gable Mountain Swamp	70,000	250
Mallard	7/8/64	Gable Mountain Swamp	27,000	NA
Teal	7/8/64	Gable Mountain Swamp	1,000	NA
Teal	7/8/64	Gable Mountain Swamp	350	NA
Teal	7/8/64	Gable Mountain Swamp	65	NA
Pintail	7/8/64	Gable Mountain Swamp	8	NA
Teal	7/15/64	Honey Hill	5,700	NA
Pintail	7/15/64	Honey Hill	230	NA
Teal	7/15/64	Honey Hill	150	NA
Mallard	7/15/64	Honey Hill	20	NA
Teal	7/15/64	Honey Hill	17	NA
Mallard	7/15/64	Honey Hill	15	NA
Mallard	7/15/64	Honey Hill	12	NA
Teal	8/15/64	Honey Hill	~1	NA
Teal	8/15/64	Honey Hill	~1	NA
Teal	8/15/64	Honey Hill	~1	NA
Teal	8/15/64	Honey Hill	~1	NA
Teal	8/15/64	Honey Hill	~1	NA
Mallard	8/31/64	Gable Mountain Swamp	26	NA
Coot	9/6/64	Gable Mountain Swamp	67	NA
Domestic	9/8/64	Gable Mountain Swamp	1,220	NA
Domestic	9/8/64	Gable Mountain Swamp	1,180	NA
Domestic	9/8/64	Gable Mountain Swamp	1,080	NA
Domestic	9/22/64	Gable Mountain Swamp	1,760	NA
Domestic	9/22/64	Gable Mountain Swamp	1,580	NA
Domestic	9/22/64	Gable Mountain Swamp	5,370	NA
Domestic	9/22/64	Gable Mountain Swamp	5,630	NA
Domestic	9/29/64	Gable Mountain Swamp	3,05[illegible]	NA
Domestic	9/29/64	Gable Mountain Swamp	82[illegible]	NA

TYPE OF FOWL	DATE	LOCATION	pCi/gm Cs-137 CONTENT OF MUSCLE	pCi/gm Sr - Total CONTENT OF MUSCLE
Coot	9/29/64	Gable Mountain Swamp	137	NA
Coot	9/29/64	Gable Mountain Swamp	102	NA
Coot	9/29/64	Gable Mountain Swamp	283	NA
Mallard	9/30/64	Gable Mountain Swamp	195	NA
Mallard	9/30/64	Gable Mountain Swamp	181	NA
Coot	9/30/64	Gable Mountain Swamp	247	NA
Shoveler	10/2/64	Gable Mountain Swamp	112	NA
Scaup	10/9/64	Gable Mountain Swamp	32	NA
Scaup	10/9/64	Gable Mountain Swamp	4	NA
Teal	10/9/64	Gable Mountain Swamp	281	NA
Gadwall	10/9/64	Gable Mountain Swamp	287	NA
Coot	10/13/64	Gable Mountain Swamp	128	NA
Scaup	11/3/64	Gable Mountain Swamp	98	NA
Scaup	11/3/64	Gable Mountain Swamp	85	NA
Scaup	11/3/64	Gable Mountain Swamp	20	NA
Scaup	11/3/64	Gable Mountain Swamp	114	NA
Scaup	11/3/64	Gable Mountain Swamp	121	NA
Scaup	11/3/64	Gable Mountain Swamp	54	NA
Scaup	11/3/64	Gable Mountain Swamp	18	NA
Mallard	11/3/64	Gable Mountain Swamp	3,020	NA
Mallard	11/3/64	Gable Mountain Swamp	869	NA
Mallard	11/3/64	Gable Mountain Swamp	1,750	NA
Pintail	11/3/64	Gable Mountain Swamp	14	NA
Teal	11/3/64	Gable Mountain Swamp	24	NA
Teal	11/3/64	Gable Mountain Swamp	23	NA
Coot	11/3/64	Gable Mountain Swamp	946	NA
Coot	11/3/64	Gable Mountain Swamp	340	NA
Coot	11/3/64	Gable Mountain Swamp	53	NA
Coot	11/3/64	Gable Mountain Swamp	47	NA
Coot	11/3/64	Gable Mountain Swamp	10	NA
Golden Eye	11/30/64	Gable Mountain Swamp	32	NA
Golden Eye	11/30/64	Gable Mountain Swamp	262	NA
Golden Eye	11/30/64	Gable Mountain Swamp	309	NA
Golden Eye	11/30/64	Gable Mountain Swamp	88	NA
Golden Eye	11/30/64	Gable Mountain Swamp	26	NA
Coot	11/30/64	Gable Mountain Swamp	1	NA
Coot	11/30/64	Gable Mountain Swamp	53	NA
Coot	11/30/64	Gable Mountain Swamp	57	NA
Coot	11/30/64	Gable Mountain Swamp	309	NA

All ducks harvested on the Hanford Reservation after January 1, 1965 have contained <200 pi/gm.

As seen in Table II, there was a continuing drop in the external contamination levels with time. The water fowl, harvested from ponds six to eight miles distance from the contaminated ponds, showed no significant external contamination. This information reinforced the belief that the water fowl present on the swamps at the time of the incident were resident fowl and stayed in the immediate vicinity. As seen in Table III, the Cs-137 content of the water fowl muscle was high. Because of this, investigations were made to determine if it was feasible to eradicate the entire water fowl population. State Game Commission people were contacted and the contamination problem discussed with them. They could suggest no good solutions but had no objections to the plant forces making efforts to exterminate these fowl. An attempt was subsequently made to poison these fowl by distributing poisoned grains in certain controlled locations near the ponds. This attempt was almost completely unsuccessful, and was discontinued after a short time. All poisoned material was removed.

A number of tame ducks were procured to use as a means to further investigate the potential external - internal radiation problem. Groups of three ducks were placed on each swamp at various times after the water contamination level dropped to where it was not considered a major problem ($<10^{-4}$ μCi/cc). These ducks were harvested when possible, after a residence time of one to two weeks in an attempt to evaluate how serious the problem of contaminating wild migratory water fowl might be. It was the opinion of some members of the Task Force that the resultant contamination of these fowl would represent a worse case since these tame ducks could not fly and were forced to scavenge all their food in the immediate vicinity of the ponds. The ducks placed

on the larger body of water showed measurable levels of external contamination and internal deposition even after the water concentrations had dropped to $<10^{-4}$ μ Ci/cc. The wild water fowl harvested at about the time the tame ducks were harvested did show somewhat lower levels of both external and internal contamination but not to the extent anticipated. The analyses of wild fowl that have been sampled since the abandonment of the Task Force indicate a reduction in Cs-137 deposition.

The tame water fowl (not shown in the tables) which were placed on "B" Swamp showed no detectable external contamination and essentially no internal deposition. This was expected since a very high percent of the activity that had been discharged in this swamp was trapped in the ditch that was later back-filled. Overall, the "B" Swamp did not prove to be a problem after the back-filling, other than that the old trench was a future potential radiation material source for vegetation uptake.

The Environmental Evaluation and Studies Section of the Battelle Northwest Laboratories conducts an annual audit* of the deposition of radioactive materials in water fowl harvested by hunters in the Hanford Area. Hunters are requested to send the heads of the fowl to Battelle Northwest Laboratories for analyses. Of the nearly 200 fowl analysed, one analysis showed 100 pCi/gm Cs-137, seven others showed detectable Cs-137 but all were less than 5 pCi/gm. The internal deposition of Cs-137 to personnel in the immediate environs caused by this incident, therefore, does not appear to be significant.

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* Battelle Northwest Laboratories Environmental Studies and Evaluation Staff, Evaluation of Radiological Conditions in the Vicinity of Hanford for 1964, ENWL - 90.

Copper sulfate was added on two occasions in Gable Mountain Swamp to eliminate the algae and invertebrate life, thus breaking important links in the food chain of the water fowl. The copper sulfate was added at a reasonably uniform rate at the inlet for about a one week period. Three parts per billion was the desired concentration. It was necessary to broadcast copper sulfate by hand in some areas of the swamp because of apparent water stagnation at these locations. Copper sulfate was not added to the "B" Swamp immediately, since most of the contamination was trapped in the long ditch which was to be backfilled. It was thought that killing the algae in the ditch might release some of the trapped material into the open pond. After the backfilling had been completed copper sulfate was added on one occasion. The addition of this chemical successfully rid the swamps of most of the algae growth. The concentrations of radioactive materials in the water was several orders of magnitude lower before algae began to grow back to any significant extent. The opportunity for algae to concentrate the activity was, therefore, significantly reduced.

Some vegetation samples were collected around the pond perimeters. Complete analyses was not made. However, it is obvious that the uptake of some of the radionuclides was significant from scanning the results in Table IV.

TABLE IV

UPTAKE OF CERTAIN RADIONUCLIDES BY VEGETATION

VEGETATION	pCi Sr-89	pCi Sr-90	pCi Cs-137
Millet Leaves			910
Millet Leaves			2,700
Millet Seed			1,700
Millet Seed			3,100
Swamp Willow Leaves	260	130	13
Swamp Willow Leaves	34	230	1
Swamp Willow Leaves	45,400	22,400	220
Swamp Willow Leaves	3,140	1,580	1,100

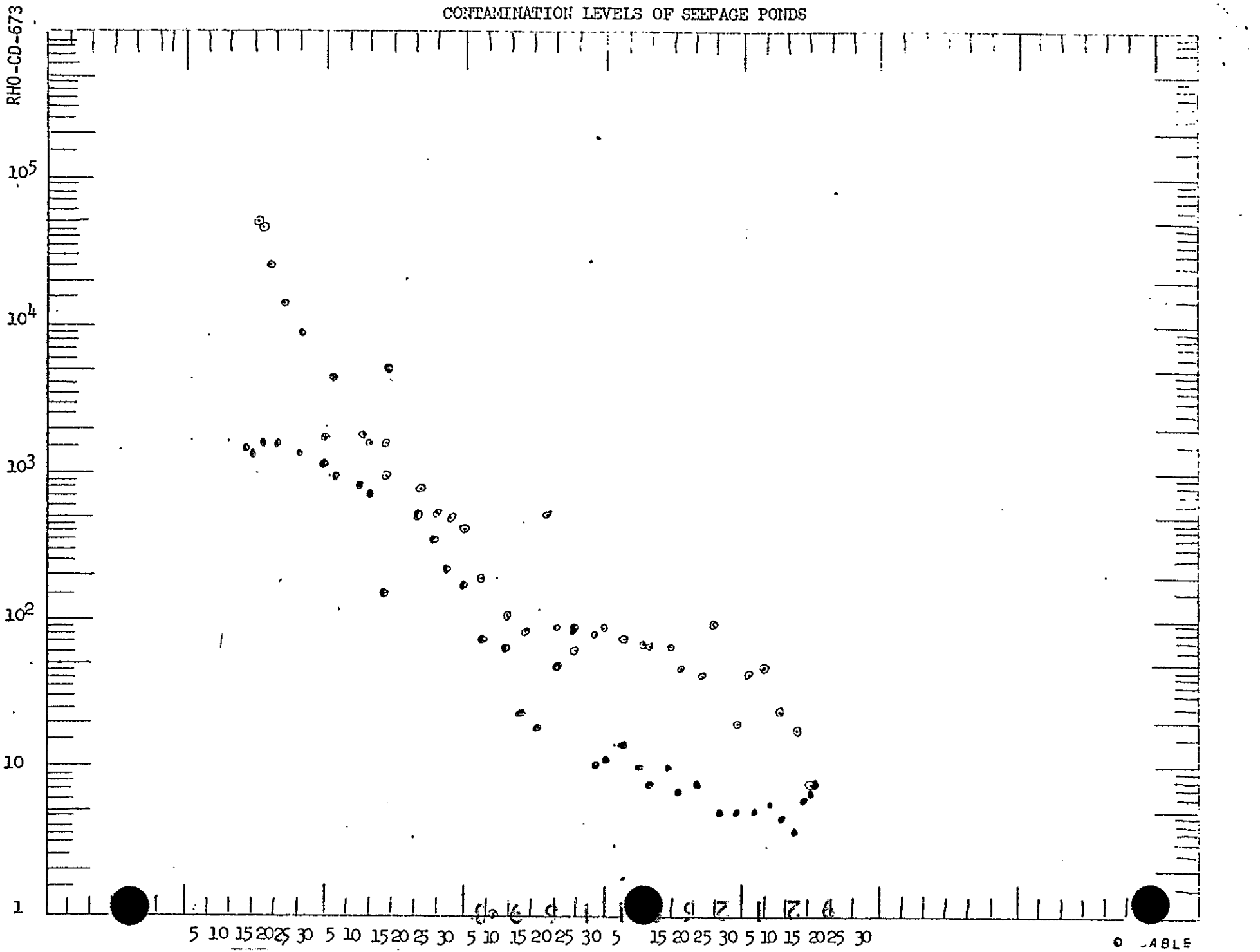
These findings indicated a definite need for a soil sterilization program and such a program was carried out. The soil sterilization program had an additional benefit in that it prevented the growth of wild grains that serve as a major food source for wild fowl. There were wild grains (millet) growing in the vicinity of these cooling water waste areas and in an attempt to make these areas as undesirable as possible to water fowl, these grains were destroyed by burning with kerosene.

As mentioned previously, the Task Force determined that it would be desirable to maintain the pond liquid levels to that that existed at the time of the incident, until the contamination level of the water dropped to less than 10^{-4} μCi/cc. Table V and Figure 1 show the rate of contamination reduction.

TABLE V

CONTAMINATION LEVELS OF SEEPAGE PONDS

DATE	GABLE MOUNTAIN SWAMP pCi/cc	B - SWAMP pCi/cc
6/16	48,000	1,500
6/17	40,000	1,400
6/19	28,000	1,700
6/23	13,000	1,700
6/26	9,600	1,400
6/30	2,500	1,100
7/2	5,000	950
7/7	2,900	840
7/10	2,200	790
7/14	2,200	5,400
7/14	1,100	150
7/21	810	550
7/24	590	400
7/28	510	260
7/31	410	160
8/4	210	75
8/7	---	60
8/11	140	33
8/14	110	29
8/18	570	57
8/21	150	83
8/25	63	12
8/28	87	13
9/1	93	19
9/4	82	10
9/8	74	8.4
9/10	70	10
9/15	71	7.8
9/17	45	8.0
9/22	43	4.4
9/25	95	4.4
9/29	29	5.1
10/2	45	4.0
10/6	46	3.5
10/9	36	5.0
10/13	28	7.9
10/16	12	12


CONTAMINATION LEVELS OF SEEPAGE PONDS
RHO-CD-673
10^5
10^4
10^3
10^2
10
1
5 10 15 20 25 30 5 10 15 20 25 30 5 10 15 20 25 30 5 15 20 25 30 5 10 15 20 25 30

Most of the contamination that reached the open ponds was actually removed by adsorption on the bottom sediments of the ponds. Some reduction also occurred through radioactive decay. After the level fell below 10^{-4} μCi/cc, it was the intent to raise the liquid level several inches anticipating that the contamination, which was practically all adsorbed on the mud, would then be inaccessible to the water fowl. In addition, the radiation levels around the ponds would be significantly reduced because of the additional water shielding. Tests were conducted using ~~diatomaceous earth~~ Bentonite clay to determine how much of this material would have to be added to reduce the percolation rate of the water through the soil to the point that the liquid level would raise on the order of one foot. These studies indicated that approximately forty tons, evenly dispersed over the pond area, should effectively plug the bottom of the pond and cause the water to rise. Application of the diatomaceous Bentonite clay earth in a satisfactory manner turned out to be a most difficult problem and after adding some six and a half tons nonuniformly through various methods, with no significant rise in the liquid level, other methods were sought. The use of airplanes to dust the diatomaceous earth on the ponds was investigated and actually would have been employed. However, bulldozers were already employed in filling the edges around the large pond and this operation proved to be more successful than was anticipated. By the time dirt was pushed into the pond an average of twenty feet all around the perimeter, the liquid level rose rapidly and before long was well above that originally planned. Apparently most of the liquid actually percolated through the soil to the ground water at the edges of the ponds.

Some studies were conducted to determine if it were possible to reduce the radioactive contamination level in the water by adding flocculation

materials and having these materials scavenge the radioactive nuclides and then deposit on the bottom sediments. Laboratory studies indicated that with the pH of the pond water (8.5 to 9.5) various scavenging agents tried should be effective in removing greater than 95% Zr-Nb-95 and the Ce-141 and 144 and approximately 80% of the Ru-103 and 106. Concentrations of fifty to one hundred parts per million were most effective. Some of the more biologically significant radionuclides, i.e. Sr-89 and 90 and Cs-137, were not removed to any measurable degree in the tests. No attempts were actually made to remove radioactive materials from the water in the ponds using these scavenge methods, however, the information generated on this subject may prove useful should future incidents occur. The types of floc used in the lab studies were $Fe(NO_3)_3$ and $FeSO_4 + KMnO_4 \rightarrow Fe(OH)_3 + MnO_2 + \cdots$.

Samples of mud from Gable Mountain Swamp were subjected to treatment with 0.1N HNO_3 in an effort to force migration of radioactive materials through the mud. No significant movement was detected after a total flow equivalent to 26 gal/ft^2. This is indicative of the tenacity with which the isotopes are bound to the sediments.

The ground water obtained from wells in the near vicinity of Gable Mountain Swamp was sampled. The wells were located generally north northeast of the pond. The analyses of the samples showed the results given in Table VI.

TABLE VI

DATE	pCi/cc
8-5-64	49
8-26-64	40
10-28-64	11

The bulk of the activity was Ru-103 and Ru-106 and some Zr-Nb-95. Samples of ground water taken from wells down gradient from those which showed contamination were at background levels. It was concluded from these results that contamination of the ground water was not a significant problem.

CONCLUSION

The Task Force was abandoned in the middle of October when it was apparent that the more serious problems were under control. The remaining radioactive materials were essentially all adsorbed on the bottom sediments of the swamp, and the rise in water level provided a reasonably good barrier for both wildlife and people. Water fowl harvested after the Task Force was dismissed did occasionally show some external contamination on the order of a few thousand counts per minute as measured with a GM Meter. Internal contamination of fowl harvested since the January 1, 1965, has been as high as 200 pCi/gm of muscle, and on the average about the same as the internal deposition noted in the caribou in Alaska.* The radiation exposure potential from this source to personnel in the environs is considered insignificant.

Close surveillance of the area will continue to be conducted because of the relatively large inventory of fission products affixed to the soil and to assure that potential vegetation contamination is under control.

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* Hanson, W. C., and Palmer, H. E., Cesium Cycle of Cs-137 In Some Alaskan Natives and Animals, HEALTH PHYSICS JOURNAL, Volume 11, 12, to be published.

SUMMARY OF THE GABLE MOUNTAIN SWAMP AND B SWAMP CONTAMINATION INCIDENT

A brief summary of the Purex Concentrated Waste Sampling Tank (F-15) coil failure and subsequent Gable Mountain Swamp and B Swamp contamination incident and action taken to date following the incident is shown below in chronological order.

June 11, 1964	A leak was detected in the F-15 coil.
June 12, 1964	Radioactive waste seeped into the coil and was subsequently flushed to the swamps. First estimates indicated the total activity to be 60,000 to 70,000 curies.
	Water and mud sampling programs were initiated. First samples indicated contamination levels in the order of tenths of μc's/cc.
	Radiation surveys were conducted; exposure rates of ~ 3 - 5 rads/hr at 3' were noted along the inlets of both swamps.
	All entry ways to the swamps were barricaded.
June 15, 1964	Biology personnel investigated the wildlife associated with the swamps and reported all fowl were residents rather than migratory animals.
June 16, 1964	A conference of Purex and Hanford Laboratory personnel was held to determine studies for ~~cause~~ course of action. The use of floc, a wildlife sampling program, Gable Mountain Swamp volume and size, and cost of construction of new inlet ditches were to be investigated.

June 18, 1964 — Recommendations were made by RPO that new swamp inlets be excavated and the old inlets backfilled. Estimated costs were $24,500.

June 19, 1964 — Equipment was moved in to Gable Mountain Swamp to start excavation. Surveys indicated no spread of contamination outside of the swamp. Water samples taken on the 16th indicated contamination levels on the order of 5×10^{-2} μc/cc and 10^{-3} μc/cc at Gable Mountain Swamp and B Swamp, respectively.

June 22, 1964 — Excavation of the new inlet started at Gable Mountain. Volume of the swamp estimate was revised upward to 20 million gallons from an earlier estimate of 8 million.

Waterfowl which had been harvested had external contamination levels of 100 mrads/hr (dial reading CP). It was recommended that the use of copper sulfate for algae kill be investigated.

June 24, 1964 — It was recommended by RPO that copper sulfate be added to Gable Mountain swamp in concentrations of ~ 3 ppm for algae and invertebrate animal kill. The activity in B swamp is concentrated in the inlet ditch which is to be backfilled so it was recommended that no copper sulfate be added at least until the old ditch is backfilled. Waterfowl sampled from Redox and U swamps showed no external contamination.

June 26, 1964 — The new Gable Mountain Swamp inlet is in use; some backfilling is still in progress. Radiation exposure rates at the inlet are now ~ 50 mr/hr at 3 feet. The addition of copper sulfate to Gable Mountain started. Purex personnel have estimated that ~ 10,000 curies of activity was discharged to the two swamps. The possibility of partially sealing the bottom of Gable Mountain Swamp to raise the liquid level after nearly all the contamination is sealed in the mud is being investigated. The excavation of a new inlet for B Swamp also started.

June 30, 1964 — The addition of copper sulfate to Gable Mountain Swamp has been completed. A second dragline is being used for B Plant Ditch excavation. It is estimated that 20 days will be required to complete the excavation.

July 1, 1964 — Investigation of the Gable Mountain Swamp indicated a reasonably good algae kill. There were a few small areas where the algae appeared to be alive.

July 2, 1964 — Water samples of Gable Mountain swamp contained < 0.2 ppm copper sulfate; however, samples of the algae that appeared to be still alive contained ~ 20 ppm and it is anticipated that it will die. The water volume of B Swamp was estimated to be 9 million gallons by CET personnel.

To date most of the effort has been devoted to Gable Mountain Swamp since it is larger and nearly all waterfowl reside in this location. Most of the activity discharged to B Swamp is contained in the long inlet ditch and it is anticipated that once it is backfilled the principal portion of the activity will be contained.

HANFORD LABORATORIES
GENERAL ELECTRIC
RICHLAND, WASHINGTON
PV352

Appendix — — — RHO-CD-673

October 7, 1964

A. R. Keene, Manager
Radiation Protection

STATUS OF THE PUREX SWAMPS - OCTOBER 7, 1964

On June 12, 1964, the B Plant and Gable Mountain waste water swamps became contaminated when a cooling coil in a Purex waste tank (F-15) failed, allowing process waste material to leak from the tank into the coil. First estimates indicated a total of about 60,000 to 70,000 curies of fission products were released, but the estimate was later revised to 10,000 curies. Radiation surveys showed exposure rates as high as 5 R per hour at the inlet to the swamps immediately after the incident, and the concentration of fission products (principally Zn-95-Nb-95, Ru-103 and Ce-141-144) in the water of the swamps approached 0.1 μc/cc. With the continued addition of "normal" (clean) water to the swamps, the concentrations of fission products in the swamp water diminished with a "half-life" of about one week. By the end of August the concentration in the water of "B" Swamp was ~10^{-5} μc/cc (near normal). Samples of water from the Gable Mountain swamp have shown considerable variation, but most results for September indicated concentrations between 10^{-5} μc/cc.

Backfilling of the original inlet areas of the swamps buried much of the contamination and reduced the dose rates. Backfilling was especially effective for "B" Swamp because of the long, vegetation filled ditch that trapped most of the contamination. With completion of backfilling of the "B" Swamp inlet ditch by mid-August, radiation levels around this swamp were reduced to less than 10,000 c/m (except for one small area that showed less than 6 mR/hour).

When a new inlet ditch for the "B" Swamp was finished and placed in service July 21, an unexpected rise in water level of the "B" Swamp began. (Perculation through the bottom of the new ditch was much less than through the old ditch---the reverse had been anticipated.) The water level in "B" Swamp stabilized at the end of August at about eight inches above the original level. This rise was beneficial in covering and providing additional shielding for the contamination fixed in the bottom sediments. Domestic ducks placed on "B" Swamp at the end of August and sampled a few days later showed no detectable external contamination, and thus satisfactory control of the contamination in this swamp.

The Gable Mountain Swamp has presented more difficult control problems than the "B" Swamp because of its larger area, short inlet ditch (that did not retain much of the contamination), and its attraction for migratory water fowl. Wild ducks and coots inhabiting the Gable Mountain Swamp at the time of the incident were found to have enough contamination to give readings as high as 100 mrads/hr on a CP instrument.

Maximum concentrations of Cs-137 in the flesh of ducks was 0.24 μc/gm. These ducks were "sampled" as rapidly as possible and copper sulfate was added to the water to kill the algae and interrupt the food chain transfer of Cs-137 to the ducks. With the approval of the State Game Department, attempts were made to poison the ducks that remained at the end of July. Poisoning was not successful, however.

In mid-August, when most of the fission products in Gable Mountain Swamp had become fixed to the bottom sediments, attempts were begun to raise the water level in order to inundate the contaminated shoreline and increase the water depth above the highly contaminated bottom. The addition of Bentonite clay was believed to be the best means of reducing perculation through the bottom of the swamp and this was begun at the end of July. By the end of August, about six tons of Bentonite had been added, essentially by hand, with no significant effect on the water level. Ducks using the swamp were much less contaminated than in June but still had as much as 100,000 c/m external contamination. In order to effect an immediate rise in water level, Purex increased the flow to the swamp. More clay was also ordered and arrangements made for application by a crop-dusting airplane.

Additional backfilling around the edges of Gable Mountain Swamp was begun in mid-September, primarily as a means of burying near-shore contamination wherever practical. Rather unexpectedly, the water level in the swamp began to rise as the backfilling proceeded, and by the end of September was up about eight inches. Application of the Bentonite has been stopped but backfilling has continued to date. Domestic ducks placed on the swamp and samples of wild ducks sampled in the area showed external contamination in the range of 3,000 to 10,000 c/m early in October. Food and other plants attractive to the ducks are to be burned in an effort to reduce the contamination level further.

Meetings between HL and Purex staff members have been held at about weekly intervals since June 16, to plan the course of action and keep abreast of the status.

Name/Type of Facility	Past Designation	Number
Ditch	--	216-A-29

Location	Service Dates	Status
200 East, Outside-East Quadrant Outside the 200 East Area east perimeter fence. The ditch empties into the 216-B-3-3 Ditch which terminates at the 216-B-3 Pond.	11/56-	Active

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-40685, W-57025 to N-43200, W-44750	H-2-2431 H-2-55900 H-2-56521 H-2-56635	Ground	575 ft
		Water Table	464 ft
		Site Depth	Not known

Source and Description of Waste

Chemical sewer waste, acid factionator condensate, and condenser cooling water from 202-A.

Description of Facility

Ditch, 6500 x 6 ft bottom dimensions.

Radionuclide Content (calculated from discharge data)

Included in 216-B-3 Pond data.

A small amount of low-level beta-gamma radioactive materials has deposited in the silt and mud in the bottom of the 216-A-29 Ditch during the years of its use. Field survey instrument readings are generally found to be less than 200 c/m with some locations ranging to 800 c/m. Traces of radioactivity have been detected in broad leaf plants growing at the water line of the ditch.

(See Attachment)

CHEMICAL [illegible]ESSING DIVISION

RADIATION OCCURRENCE

OF Beaulieu, Manager
Purex Operations

RADIATION OCCURRENCE FACTS

DATE	TIME
5/25/71	0900

LOCATION: Purex Chemical Sewer Damsite 200E

RADIATION OCCURRENCE TYPE: 3-B

CAUSE CODE: Undetermined

COMPLETE DESCRIPTION AND CAUSE

Surveys, prompted by a report from Waste Management Radiation Monitoring, of fission products contamination at the Purex chemical sewer damsite revealed the following:

Contamination in mud and algae at the water's edge on the south side of the dam: from 10,000 to 40,000 c/m
Contamination in gravel 10' up the bank from the water's edge - from 1000 to 10,000 c/m
Contamination in gravel 15' up from water's edge: 300 to 1000 c/m
Contamination along water's edge on north side of dam 5' to 15' from outflow: 300 to 5000 c/m

Observations:

Investigation was made in an effort to determine the source and cause of the contamination at the damsite. The 206-A Vacuum Fractionator discharge waters appeared the most likely source but evaluation of past samples failed to conclusively determine the actual cause. Investigation continues.

9 2 1 2 3

RECEIVED
JUN 21 1971
G. E. BACKMAN

CC:
BJ McMurray (2)
GE Backman (2)
CW Malody
HL Caudill
RN File (WDK)

ACTION TAKEN
1. Surveys made.
2. Area @ damsite zoned.
3. Investigation initiated.

INVESTIGATED BY: WD Killand/BW Marsh

DATE OF INVESTIGATION: 5/25/71

[illegible]ED EMPLOYEES

None

Name/Type of Facility	Past Designation	Number
Crib		216-A-30

Location	Service Dates	Status
200 East, Outside-East Quadrant East of 202-A. Approximately 3000 ft outside 200 East Area perimeter fence.	1/61-	Active

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-39150, W-44990 to N-39735, W-46260	H-2-57719 H-2-57720	Ground Water Table Site Depth	575 ft 404 ft(1973) 12 ft

Source and Description of Waste

3.72×10^9 liters. Liquid waste from 202-A: steam condensate; equipment disposal tunnel floor drainage; water-filled door drainage; slug storage basin overflow. Low salt, neutral/basic.

Description of Facility

Crib, stone-filled; 1400 ft x 10 ft.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	<71	< 73.0
Beta, Ci	5500	< 585.0
^{90}Sr, Ci	190	137.0
^{106}Ru, Ci	200	.379
^{137}Cs, Ci	220	154.0
^{60}Co, Ci	16	2.36
U, kg	<41	< 44.0
^{233}U, g	7.5	< 7.48

History:

During the winter months of 1971-72, an alkaline deposit was observed to be forming over the ground surface the entire length of the 216-A-30 Crib. It appeared to be a salt residue that was condensing out from vapors being emitted through the porous ground surface of the crib.

216-A-30 continued

History:

Generally the deposit read 400 to 600 c/m beta-gamma activity. A few tumbleweeds were found that contained strontium and cesium radioactivity to a maximum of 1200 c/m. An exploratory excavation was made into the crib. Dose rates to 800 mrads/hr were encountered at a depth of 4 feet below the ground surface. This appeared to be the top of the crib gravel fill which had been covered with 4 feet of soil.

In June, 1972, corrective action was taken that included the following:

1. Vegetation was bladed from the surface of the crib.
2. The rough ground surface was covered with a 3-inch pad of sand.
3. The sand was covered with sheets of 10 mil plastic, 60 feet wide over the entire length of the crib. (The plastic sheets were overlapped 2 feet at the joint.)
4. The plastic was covered with 20 inches of sand.
5. The job was finished with a 4-inch overlay of gravel to protect against wind erosion.

No salt or radioactivity have been observed on the surface of the crib since the corrective work was done in 1972.

Name/Type of Facility	Past Designation	Number
Crib	216-A-34	216-A-34

Location	Service Dates	Status
200 East, Outside-East Quadrant ~300 ft East of Canton Ave., ~900 ft northeast of 241-A Tank Farm.	11/56-12/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-41710, W-46800 to N-41875, W-46540 N-41775, W-46688 to N-41900, W-46680	H-2-44501 H-2-57110	Ground Water Table Site Depth	659 ft 404 ft NA

Source and Description of Waste.

Volume unknown. Cooling water from the contact condenser in the 241-A-431 Bldg.

Description of Facility

Two ditches, 280 ft x 30 ft and 130 ft x 30 ft. Deactivation: effluent pipeline to the ditches was blanked off and the ditches backfilled.

Radionuclide Content (calculated from discharge data)

Total Beta: <1 Ci

Name/Type of Facility	Past Designation	Number
Crib		216-A-37

Location	Service Dates	Status
200 East, Outside-East Quadrant ~2000 ft East of the 202-A Bldg.	3/77-	Active

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-39856, W-45816 to N-40157, W-46449	H-2-62876 H-2-62877	Ground Water Table Site Depth	719 ft 403 ft Not known

Source and Description of Waste

Process condensate waste from the 242-A Evaporator.

Description of Facility

Crushed stone crib, 700 ft x 10 ft bottom dimensions.
The condensate pipeline enters the crib at the extreme S.E. end of the crib.

Radionuclide Content (calculated from discharge data)

Radionuclide	At time of Discharge	As of 6/30/78
Pu, g	$< 2.11 \times 10^{-2}$	$< 2.11 \times 10^{-2}$
Beta, Ci	< 0.337	< 0.265
^{90}Sr, Ci	$< 5.55 \times 10^{-3}$	$< 5.47 \times 10^{-3}$
^{106}Ru, Ci	$< 6.46 \times 10^{-2}$	$< 4.42 \times 10^{-2}$
^{137}Cs, Ci	$< 1.33 \times 10^{-2}$	$< 1.30 \times 10^{-2}$

Name/Type of Facility	Past Designation	Number
Lined Holding Trench	None	216-A-42

Location	Service Dates	Status
200 East, Outside - East Quadrant Directly east of 216-A-6 Crib. East of Purex, 202-A.	1978	Active

Site Coordinates (Approximate) Centerline		Reference Drawings	Elevations
N-40179 W-46749	N-39900 W-46500	H-2-64929	

Source and Description of Waste

The facility would intercept out of specifications process cooling water and concentrator boil off liquid waste from the 202-A Building.

Description of Facility The facility consists of three holding basins, each lined with a rubber bag to contain accidental releases of radioactive liquid waste. The built-in recovery system provides the capability of pumping back into the Purex facility for reprocessing.

Radionuclide Content (calculated from discharge data)

The capacity of the three basins is in excess of 1.6 million gallons.

March 14, 1979 - Has not been used.

Name/Type of Facility	Past Designation	Number
Pond	B-Swamp 216-B-3 Swamp	216-B-3

Location	Service Dates	Status
200 East, Outside, East Quadrant Approximately 5000 ft NE of the 202-A Bldg.	4/45-Present	Active

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-43967, W-44787 N-42468, W-41745	H-6-418 H-2-2431	Ground Water Table Site Depth	576 ft 420 ft(1973) 0 ft

Source and Description of Waste

Receives 221-B low-level wastewater and 202-A chemical sewer waste via the 216-B-3 Ditch. Total volume estimated to be 9.2×10^{10} liters as of 12/31/73. The Purex process cooling water may also be diverted into the 216-B-3 Pond.

Description of Facility

A 46 acre cooling water receiving pond, without outlet overflow.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 12/31/73
Pu, g	$<2.4 \times 10^2$	
Beta, Ci	2.3×10^4	
^{90}Sr, Ci	1.5×10^2	
^{106}Ru, Ci	2.3×10^3	
^{137}Cs, Ci	1.5×10^2	
^{60}Co, Ci	<20	
U, kg	$<3.7 \times 10^2$	
U, g	<30	

History:

Purex Plant Release - 1964:

(Next Page)

216-B-3 continued

History:

In the 1964 incident, approximately one fourth of the released activity ended up in the B-3-1 Ditch and the B-3 Pond. Initial surveys showed gamma radiation levels as high as 5 R/hr at 8 feet from the pond inlet. Further surveys showed that algae, particularly along the B-3-1 Ditch, had concentrated the radiation materials until radiation levels of 7 to 50 rads/hr were detected over the areas of concentrated algae growth. It is estimated that 3 curies of activity ended up in the 216-B-3-1 Ditch and the 216-B-3 Pond.

The following radiation levels were detected during surveys on 6-12-64:

B Swamp and Ditch

On bank over inlet	2 R/hr at 8'
At edge of inlet flume	5 R/hr at 5'
	7 R/hr at 2"
	50 Rads/hr at 2" (on algae
Maximum along road parallel to swamp	150 MR/hr
Along ditch bank (several locations)	2.5 R/hr at 2"
	3.2 R/hr at 2"
	600 MR/hr at 2"
Along shoreline of swamp	3000 c/m

Note: See 216-A-25 for additional details of this incident.

OFFICIAL USE ONLY

B-Plant Release - 1970:

PART - II
221-B BUILDING
STRONTIUM 90 RELEASE
MARCH 22, 1970
Contract AT(45-1)-2130

SUMMARY

An estimated 1,000 curie strontium 90 release occurred at B Plant during an attempted measurement of the liquid level in the strontium 90 product storage tank 8-1, March 22, 1970. A portable manometer system (temporary instrumentation) was being used during an upgrading program of the normal tank instrumentation. A leak at or near the gallery end of a Tygon tubing manometer sending line allowed strontium 90 bearing solution to be pumped from the storage tank out through the leak in the sensing line by an airlift action created by purge air (air used for the dilution of radiolytically produced free hydrogen). This purge air was expelled through a line deep in the 8-1 tank, and bubbled up the adjacent weight factor line. This airlift pumping action was stopped by removing the connecting pipe jumper in the canyon cell. The product solution entered the pipe gallery floor drain and the chemical sewer, which empties into the "B" ditch (an open ditch and some tile line approximately a mile and one half long) that empties into the "B" swamp (an open 25 acre pond). Radiation levels of 500 rads/hour at three or four inches existed in the pipe gallery. Water samples taken from the "B" swamp reached a maximum strontium 90 concentration of 1.7×10^{-3} uCi/ml.

ADDITIONAL RADIATION MONITORING INFORMATION

A. 216-B-3 Swamp

Total Beta Activity in Ci/ml

Date	B Swamp (Open Pond)	B Swamp (Inlet Ditch)
3-23	$<4.0 \times 10^{-6}$	1.6×10^{-2}
3-24	1.7×10^{-3}	1.5×10^{-2}
3-25*	8.9×10^{-4}	1.5×10^{-5}
3-26	8.3×10^{-4}	8.4×10^{-6}
3-27	7.6×10^{-4}	1.4×10^{-5}

* Purex cooling water added for dilution and water level control of the open pond.

216-B-3 continued

The estimate of the release to the 216-B-3 Pond and the 216-B-3-2 Ditch is as follows:

Total beta (curies)	154
Cesium 137 (curies	13
Strontium 90 (curies)	50
Ce Pr 144 (curies)	54

216-B-3 continued

Date: April 13, 1970

To: B. J. Murphy

From: H. L. Maxfield

Subject: MANAGEMENT REPORT - APRIL 1970

216-B-3 Pond

Two dozers were used to push dirt over the contaminated sides of the B-3 Ditch and over the contaminated south, west, and north shorelines of the B-3 Pond. Radioactivity in the ditch has been reduced from a maximum of 2 rads/hour at the head of the ditch to 70,000 c/m (9 mrads/hr) on a few weeds blown into the center of the ditch. Generally, the ditch banks to waters edge read 200 c/m. The pond shoreline activity has been reduced from a maximum of 130 CP window open reading (650 mrads/hour) at the ditch inlet to 65,000 c/m (approximately 10 mrads/hour) at that same location. Readings elsewhere range from 1,000 c/m to 25,000 c/m.

The wind driven waves deposit radioactive small floating debri, such as pieces of broken Russian thistle, onto the shores of the pond. While this does not constitute a food hazard to waterfowl, it reflects background readings that are higher than the true radioactivity of the pond water.

Until further notice, we will continue to take daily water samples at the head of the ditch, at the pond south mid shorelines, and at the pond northeast shoreline. Background readings in the B-3 Ditch inlet and outlet and at seven locations along the B pond shoreline will also be taken daily.

Six gas operated cannons have been placed along the edge of the pond and ditch to help keep waterfowl from these waters. They are not fully effective after two or three days. Battelle environmental samplers have been able to kill or drive off most of the coot population. It has been reduced from approximately one hundred to fifteen coots.

During the ensuing summer months, radioactive vegetation was found to be growing in the B-3-2 Ditch and around the shoreline of the B-3 Pond. This finding prompted action to abandon and cover the 216-B-3-2 Ditch and to decontaminate and further build up the shoreline of the 216-B-3 Pond.

216-B-3 continued

Management Report - Radiation Monitoring, October, 1970.

"Work was completed October 29, 1970 on decontamination of the shoreline of the B-3 Pond. This was accomplished by removing all radioactive tumbleweeds from the edge of the pond, lowering the level of the pond water; dozing the contaminated undersoil into the pond area as far as possible; diking the north, south, and west shorelines with three feet of sand and gravel; then raising the level of the pond to flood over all contaminated ground surfaces."

Name/Type of Facility	Past Designation	Number
Ditch (covered)	B-Swamp Ditch	216-B-3-1

Location	Service Dates	Status
200 East, Outside-East Quadrant	4/45-7/64	Covered

Site Coordinates (Approximate)	Reference Drawings	Elevations
Head end N-43700, W-47000		

Source and Description of Waste

Received process vessels cooling water from 221-B and 202-A processing plants.

Description of Facility

Originally an open ditch feeding process vessel cooling water into the 216-B-3 Pond.

Radionuclide Content (calculated from discharge data)

An estimated total of 3 curies of mixed fission products at the time it was abandoned.

History:

The 216-B-3-1 Ditch was used from startup of the 221-B Plant in 4/45 until it was covered July 21, 1964, following the Purex June 12, 1964, incident. Re: 216-A-25.

During the subsequent years contaminated Russian thistle were found to be growing profusely over areas of the covered ditch. Radiation readings were found to a maximum of 40 mrads/hr on surfaces of the thistles.

In 1971, Plant Maintenance forces under Contingency Maintenance Request MA-131 took corrective action to eliminate the growth of radioactive plants. The work consisted of leveling and cleaning the ground of all foreign objects, such as rocks, sticks and other debris that might puncture a plastic sheet. On the leveled ground was placed a 4-inch cushion of sand and over the sand cushion were placed sheets of 10 mil thick plastic (32 ft. wide by 100 ft long per sheet). The sheets were overlapped two feet to provide an effective plant root barrier. The sheeting was covered with 18 inches of sand and topped with 4 inches of gravel to prevent surface erosion by the wind.

216-B-3-1
UN-216-E-18 continued

History:

The entire ditch was treated in this manner excepting the first 100 feet at the head end near the diverter station. At the eastern end of the ditch where the ditch had widened into a swamp, the treated area is approximately 100 feet wide. The upper ditch (west end) is 32 feet wide. A total of 384,000 square feet of plastic was used on the project.

The plastic barrier has been effective in limiting radioactive weed growth over the 216-B-3-1 Ditch. Since its installation in 1971 to date-March 1978, there have been only 9 radioactive Russian thistle found growing on the subject area. All plant life appears greatly stunted, probably due to high ground temperature and reduced moisture above the plastic barrier.

Name/Type of Facility	Past Designation	Number
Ditch		216-B-3-2

Location	Service Dates	Status
200 East, Outside-East Quadrant	7/64-9/30/70	Covered

Site Coordinates	Reference Drawings	Elevations
Head end N-43450, W-46800		

Source and Description of Waste

Received process vessels cooling water from 221-B and 202-A processing plants.

Description of Facility

Open trench from the Diverter station to the 216-B-3 Pond. Average width of 15 feet at ground level. Depth from 4 to 8 feet.

Radionuclide Content - Unknown

Inventory included in the 216-B-3 Pond Record.

History:

The 216-B-3-2 Ditch was dug and put into service July 1964 as a replacement for the abandoned 216-B-3-1 Ditch. It transported process vessels cooling water from B-Plant and Purex Plant to the 216-B-3 Pond without incident until March 22, 1970. A radiation release on that date in the 221-B facility grossly contaminated the 216-B-3-2 Ditch. It was reported as follows:

PART - II
221-B BUILDING
STRONTIUM 90 RELEASE
MARCH 22, 1970
Contract AT(45-1)-2130

SUMMARY

An estimated 1,000 curie strontium 90 release occurred at B Plant during an attempted measurement of the liquid level in the strontium 90 product storage tank 8-1, March 22, 1970. A portable manometer system (temporary instrumentation) was being used during an upgrading program of the normal tank instrumentation. A leak at or near the gallery end of a Tygon tubing manometer sending line allowed strontium 90 bearing solution to be pumped from the storage tank out through the leak in the sensing line by an airlift action created by purge air (air used for the dilution of radiolytically produced free hydrogen). This purge air was expelled through a line deep in the 8-1 tank, and bubbled up the adjacent weight factor line. This airlift pumping action was stopped by removing the connecting pipe jumper in the canyon cell. The product solution entered the pipe gallery floor drain and the chemical sewer, which empties into the "B" ditch (an open ditch and some tile line approximately a mile and one half long) that empties into the "B" swamp (an open 25 acre pond). Radiation levels of 500 rads/hour at three or four inches existed in the pipe gallery. Water samples taken from the "B" swamp reached a maximum strontium 90 concentration of 1.7×10^{-3} uCi/ml.

ADDITIONAL RADIATION MONITORING INFORMATION

A. 216-B-3 Swamp

Total Beta Activity in uCi/ml

Date	B Swamp (Open Pond)	B Swamp (Inlet Ditch)
3-23	4.0×10^{-6}	1.6×10^{-2}
3-24	1.7×10^{-3}	1.5×10^{-2}
3-25*	8.9×10^{-4}	1.5×10^{-5}
3-26	8.3×10^{-4}	8.4×10^{-6}
3-27	7.6×10^{-4}	1.4×10^{-5}

* Purex cooling water added for dilution and water level control of the open pond.

Date	B Swamp (Open Pond)	B Swamp (Inlet Ditch)
3-30	6.8×10^{-4}	1.6×10^{-5}
3-31	5.4×10^{-4}	3.3×10^{-6}
4-01	8.4×10^{-4}	3.4×10^{-4}
4-02	5.2×10^{-4}	5.0×10^{-4}
4-03**	5.0×10^{-4}	3.0×10^{-5}
4-04	4.8×10^{-4}	$<2.5 \times 10^{-6}$
4-05	4.5×10^{-4}	$<2.5 \times 10^{-6}$
4-06	3.6×10^{-4}	$<2.5 \times 10^{-6}$

** The chemical sewer and head end of the open ditch were completely isolated from the balance of the ditch and swamp by back filling part of the ditch.

216-B-3-2
(UN-216-E-19) continued

History:

Subsequent to the incident, action was taken in July 1970 to push in the sides of the 216-B-3-2 Ditch in order to cover the contamination in the bottom of the ditch with a foot of clean soil. This action was deemed necessary to isolate the ditch contamination from the feeding water fowls. The foot of dirt reduced maximum dose rates at the head end of the ditch from 450 mrads/hr to a maximum of 20 mrads/hr. General activity along the ditch was reduced from 10,000 c/m to 200 c/m.

The finding of rabbit and deer droppings September 1, 1970, near the 216-B-3 Pond reading a maximum of 7500 c/m prompted a search to determine the radioactive food source of these animals.

It was found that in addition to the tumbleweeds, at least three different varieties of broad leaf plants were growing within six feet of the water edge of the B-Pond. Tumbleweeds read a maximum of 30,000 c/m and the broad leaf plants a maximum of 2,500 c/m. Some of the plants had been cropped as if they had been grazed by animals. A rabbit was observed nibbling on a root at the base of a green tumbleweed.

The investigation continued September 2, 1970 in the Purex Chemical Sewer ditch and the B-3 Ditch to the B-Pond. A maximum of 700 c/m radioactivity was found on a few bunches of grass at the edge of the Purex Chemical Sewer stream. One sample of mud taken from the stream bottom read 20,000 c/m. The 216-B-3 Ditch was found full of tumbleweeds and a variety of broad leaf plants growing from the water's edge to the shoulders of the ditch bank. The broad leaf plants near the water were found to contain radioactivity to a maximum of 3,500 c/m. The tumbleweeds contained a maximum of 40,000 c/m.

As a result of the above findings, a new ditch, the 216-B-3-3, was dug to replace the contaminated 216-B-3-2 Ditch. The new ditch was put in service September 30, 1970. The contaminated weeds on the upper sides of the old ditch were scraped into the bottom of the ditch. That portion of the ditch from approximately 100 yards east of the confluence of the 216-A-29 Ditch (Snow's canyon) to the head end of the ditch was dozed full of clean dirt. The east end of the 216-B-2 Ditch from Snow's Canyon to the pond was used as a depository for contaminated Russian thistle removed from the shoreline of the pond. This portion of the ditch was then filled with clean dirt to within 2 feet of grade level. A plastic sheet 10 mils thick was then laid over the ditch and covered to grade level with clean soil, topped with gravel to reduce erosion from high winds.

VOLUME III SOUTH OF 200 EAST AREA QUADRANT (S-200 E)

Waste Disposal Sites and Associated Radiation Zones

Quadrant Boundaries

East Boundary	-	Du Pont Avenue
South Boundary	-	The first ridge south of Rockwell Street.
West Boundary	-	Isochem Avenue (Powerline Road)
North Boundary	-	Highway 4-S

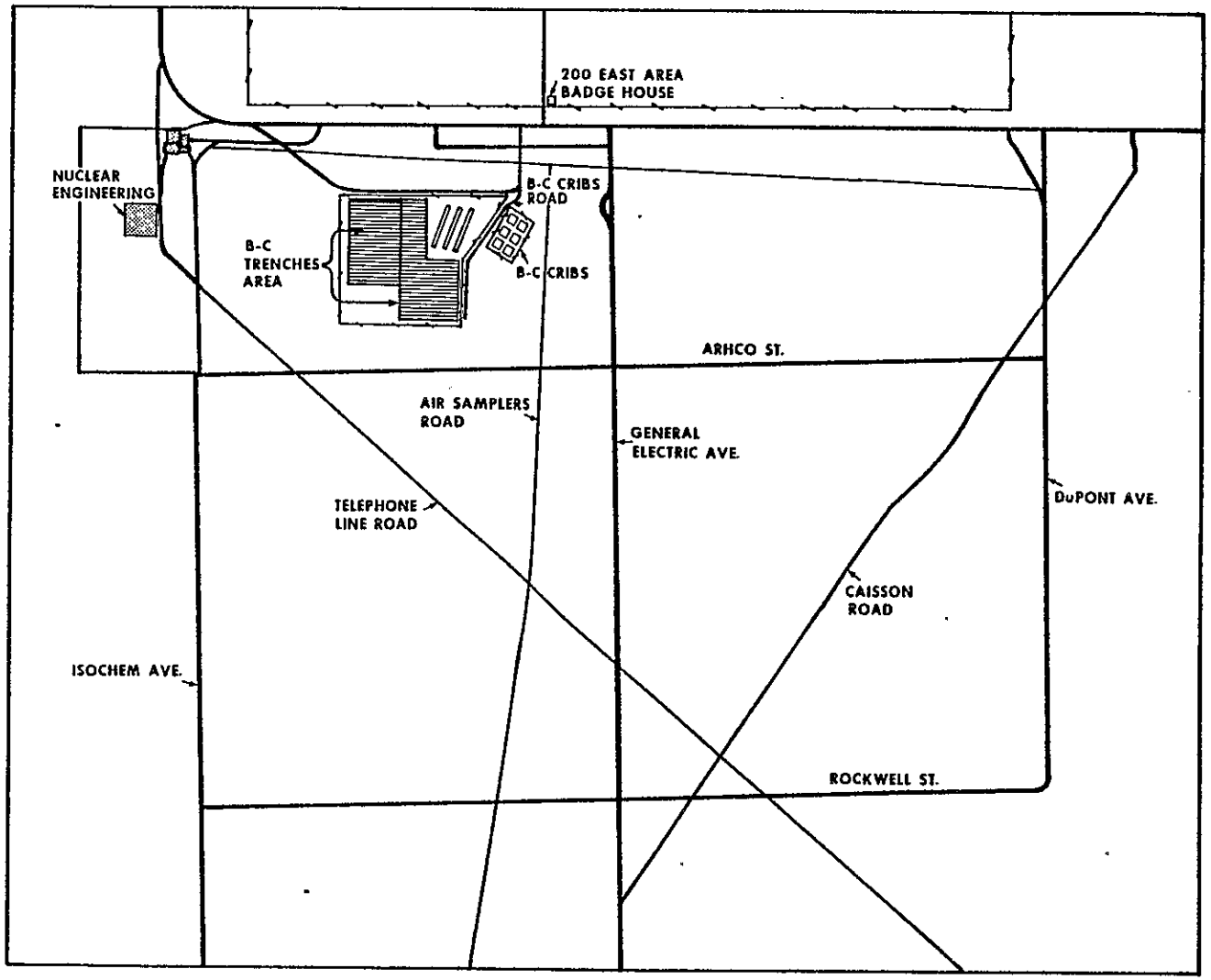
See Quadrant maps at the end of this section.

How to read the Index and locate a site:

Example - UN-216-E-11 Unplanned Release Site

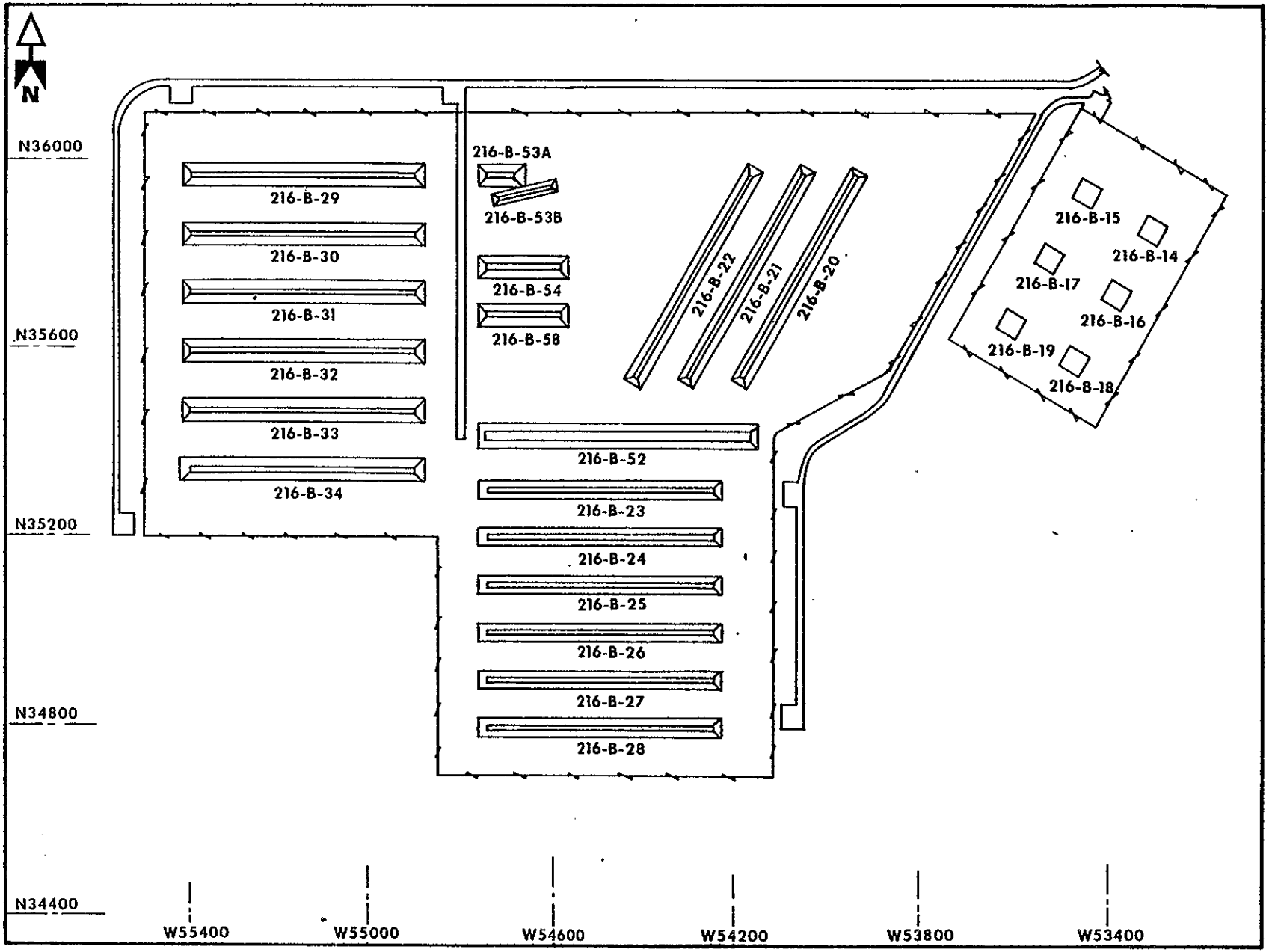
Site Number	Volume	Quadrant
UN-216-E-11 Unplanned Release Site	III.	S-200 E

B-C CRIBS CONTROLLED AREA
UN-216-E-11

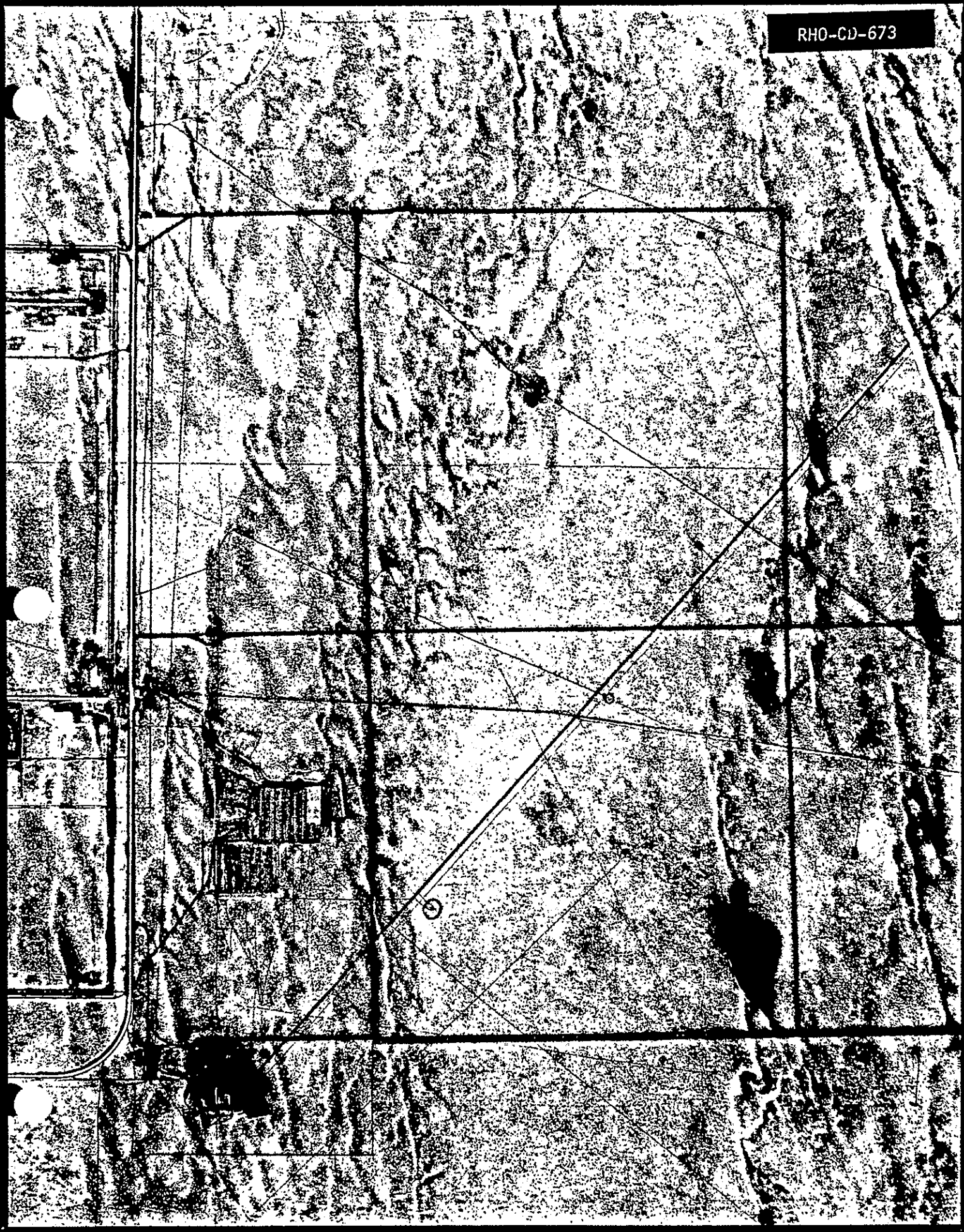


RHO-CD-673

B-C CRIBS AREA



RHO-CD-673


RHO-CD-673

INDEX - VOLUME III OUTSIDE 200 EAST AREA

South Quadrant

Name/Type of Facility	Past Designation	Number
Crib	216-BC-1 Crib	216-B-14

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway)	1/56-2/56	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-35955, W-53309	H-2-2907 H-2-2932 H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 404 ft (1973) 13 ft

Source and Description of Waste

8.71 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 40 ft x 40 ft bottom surface area, steel form on a concrete block structure, resting on wooden plank. The pipeline to the crib was valved out when the crib was deactivated.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	25	25.0
Beta, Ci	1.4 x 10^5	<766.0
^{90}Sr, Ci	400	233.0
^{106}Ru, Ci	5.9 x 10^4	1.52 x 10^{-2}
^{137}Cs, Ci	250	151.0
^{60}Co, Ci	5	0.275
U, kg	220	218.0

Other Potential Hazards

Wooden structure of crib may collapse. Prompt remedial action would be required to prevent spread of contamination and to correct other hazards.

Site Characterization Status

The 216-B-14 Cribs is the first in a series of cribs and trenches that received 1.2 x 10^8 liters of high-salt scavenged waste from U-Plant during the period January 1956 to December 1957. This combined facility, known as the BC disposal site, received the greatest amount of radioactivity disposed of at any one site on the Hanford Project (9.2 x 10^5 gross beta curies). The scavenged waste was

216-B-14 continued

Site Characterization Status

disposed to these cribs and trenches on a specific retention basis whereby disposal volumes were much less than the total pore volume of the soil underlying the cribs and trenches.

Three wells were drilled at the BC Site in 1966 to determine the distribution of radionuclides below selected areas (near cribs and trenches receiving the greatest amount of ^{90}Sr and ^{137}Cs). The results of core analysis from these wells indicated that the bulk of the long-lived radionuclides were retained high in the soil column, from 150 to 250 ft above the water table as it existed at that time.

The ground surface of the radiation zone enclosing cribs B-14, 15, 16, 17, 18, and 19 is covered with radioactive rabbit droppings ranging from 1000 c/m to >100,000 c/m. The activity was deposited in the late 1950's when rabbits or other animals dug into the nearby liquid waste trench, 216-B-28 and used it as a "salt lick".

The radioactive rabbit droppings are all old material and are well contained in the heavy mat of vegetation growing on the ground surface. Resuspension of radioactive particles does not appear to be a problem at this time.

Name/Type of Facility	Past Designation	Number
Crib	216-BC-2 Crib	216-B-15

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	4/56-12/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35935, W-53447	H-2-2907 H-2-2932 H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 13 ft

Source and Description of Waste

6.32×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 40 ft x 40 ft bottom surface area, steel form on concrete block structure, resting on wooden (fir) plank.
Deactivation: The pipeline to the crib was blanked out when the crib reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5	5.0
Beta, Ci	6.9×10^4	<484.0
^{90}Sr, Ci	200	118.0
^{106}Ru, Ci	2.2×10^4	6.78×10^{-3}
^{137}Cs, Ci	200	122.0
^{60}Co, Ci	5	0.291
U, kg	100	104.0

Other Potential Hazards

Wooden crib may collapse. Prompt remedial action would be required to prevent spread of contamination and correct other hazards.

Site Characterization Status

Refer to 216-B-14

Name/Type of Facility	Past Designation	Number
Crib	216-BC-3 Crib	216-B-16

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway)	4/56-8/56	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-35716, W-53389	H-2-2907 H-2-2932 H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 404 ft (1973) 13 ft

Source and Description of Waste

5.6 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 40 ft x 50 ft bottom surface area, steel form on concrete block structure, resting on wooden (fir) plank.
Deactivation: Pipeline to crib was valved out.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	10	10.0
Beta, Ci	5.4 x 10^4	< 1580.0
^{90}Sr, Ci	700	408.0
^{106}Ru, Ci	1.3 x 10^4	3.34 x 10^{-3}
^{137}Cs, Ci	650	392.0
^{60}Co, Ci	5	0.275
U, kg	320	322.0

Other Potential Hazards

Wooden structure may collapse. Prompt remedial action would be required to prevent spread of contamination and to correct other hazards.

Site Characterization Status

Refer to 216-B-14

Name/Type of Facility	Past Designation	Number
Crib	216-BC-4 Crib	216-B-17

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway)	1/56-1/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35796, W-53527	H-2-2907 H-2-2932 H-2-3232	Ground Water Table Site Depth	740 ft 404 ft(1973) 13 ft

Source and Description of Waste

3.41 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 40 ft x 40 ft bottom surface area, steel form on concrete block, resting on wooden (fir) plank.
Deactivation: Pipeline to crib was valved out.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	10	10.0
Beta, Ci	2000	<441.0
^{90}Sr, Ci	160	93.2
^{106}Ru, Ci	250	6.42×10^{-5}
^{137}Cs, Ci	220	133.0
^{60}Co, Ci	1	5.50×10^{-2}
U, kg	350	354.0

Other Potential Hazards

Wooden structure may collapse. Prompt remedial action would be required to prevent spread of contamination and to correct other hazards.

Site Characterization Status

Refer to 216-B-14

Name/Type of Facility	Past Designation	Number
Crib	216-BC-5 Crib	216-B-18

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway)	3/56-4/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35577, W-53469	H-2-2907 H-2-2932 H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 404 ft(1973) 13

Source and Description of Waste

8.52×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 40 ft x 40 ft bottom area, steel form on concrete block structure, resting on wooden (fir) plank.
Deactivation: Pipeline to crib was valved out. Wooden structure of crib has collapsed, leaving a 4 ft diameter, 3.5 ft deep hole (Reference ARH-3046).

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	10	10.0
Beta, Ci	5.1×10^4	< 517.0
^{90}Sr, Ci	190	111.0
^{106}Ru, Ci	1.9×10^4	4.88×10^{-3}
^{137}Cs, Ci	250	151.0
^{60}Co, Ci	5	0.275
U, kg	240	236.0

Other Potential Hazards

Wooden structure may collapse. Prompt remedial action would be required to prevent spread of contamination and to correct other hazards.

Site Characterization

Refer to 216-B-14
This crib suffered a cave-in in 1974; which has since been filled with gravel.

Name/Type of Facility	Past Designation	Number
Crib	216-BC-6 Crib	216-B-19

Location	Service Dates	Status
200 East, Outside-South Quadrant B-C Crib Area, South of 200 East Area	2/57-10/57	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-35657, W-53607	H-2-2907 H-2-2932 H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 404 ft(1973) 13 ft

Source and Description of Waste

6.4 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 40 ft x 40 ft bottom surface area, steel form on concrete block structure, resting on wooden (fir) plank.
Deactivation: Pipeline to crib was valved out.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	10	10.0
Beta, Ci	1.1 x 10^4	<559.0
^{90}Sr, Ci	200	119.0
^{106}Ru, Ci	5100	2.61 x 10^{-3}
^{137}Cs, Ci	270	167.0
^{60}Co, Ci	5.0	0.314
U, kg	180	181.0

Other Potential Hazards

Wooden structure may collapse. Prompt remedial action would be required to prevent spread of contamination and to correct other hazards.

Site Characterization Status

Refer to 216-B-14

Name/Type of Facility	Past Designation	Number
Crib (Trench)	216-BC-7 Trench 216-B-20 Trench	216-B-20

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway)	8/56-9/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35540, W-54190 to N-35970, W-53940	H-2-3203 H-2-3204 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.68 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 ft x 10 ft bottom surface. Trench construction.
Deactivation: Overground pipeline to the BC trenches from the BC crib line was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	1.3	1.30
Beta, Ci	3.2 x 10^4	<2670.0
^{90}Sr, Ci	790	460.0
^{106}Ru, Ci	10,000	2.56 x 10^{-3}
^{137}Cs, Ci	1,500	907.0
^{60}Co, Ci	4.4	0.242
U, kg	350	352.0

Other Potential Hazards

Wind erosion of ground surface, animal burrowings, and radioactive weed growth.

Site Characterization Status

Refer to 216-B-14

History: See next page.

216-B-20 continued

History:

From 1952 to 1958, wastes containing the uranium and the aged fission product wastes produced by the now obsolete bismuth phosphate separations process were removed from underground storage tanks. After the uranium was recovered, the cesium and strontium content of the effluent stream was reduced by precipitate scavenging, and the supernatant liquor released to ground in the B-C Cribs and trenches. The specific volume of scavenged waste liquid which would be retained by the soil above the water table was transferred into the bottom of the unlined trenches, which were then backfilled with soil.

Trench 216-B-20 was the first B-C trench to receive this supernatant, August 1956. A total of 16 trenches, 216-B-20 through 216-B-34 and trench 216-B-52, received scavenged supernatant. The last recorded activity was January 1958.

A series of four trenches on the north side of the radiation zone enclosing this complex of trenches received liquid wastes generated in the 300 Area. They included the following:

216-B-53A	10/65-11/65	PRTR Waste
216-B-53B	11/62- 3/63	300 Area Waste
216-B-54	3/63-10/65	300 Area Waste
216-B-58	11/65- 6/67	300 Area Waste

In May of 1958, radioactive rabbit and coyote dung were found scattered over the ground surface of the BC Cribs and trenches area. It is postulated that a badger or some other animal burrowed into the 216-B-28 backfilled trench and a salt layer was exposed. Rabbits subsequently used the burrow as a means of reaching radioactive materials in the trenches. These chemicals served as a "salt lick". After the discovery of the burrow, it was filled with gravel and sealed over with asphalt. However, rabbits had ingested the contaminated salts and defecated over approximately four square miles of undisturbed sagebrush land depositing animal feces on the ground as far as two-and-one-half miles from the original site of the burrow. This contaminated land surrounds the B-C Cribs and trenches on three sides, extending primarily to the south and east and is the designated B-C Cribs Controlled Area.

In 1969 contaminated Russian thistles were found to be growing over trenches 216-B-53A, 53B, and 54. The thistle contained cesium 137 and strontium 90 activity to maximum dose rates of 1500 mrads/hour. The contaminated weeds were removed and buried. Action was taken to inhibit radioactive weed growth on the trenches. This included bringing all trenches to ground level 10 feet above the bottom of each trench by the addition of sand fill topped with gravel. All trenches excepting 216-B-20, 21, and 22 and 216-B-28 (blacktopped area) were so treated. Trenches 20, 21, and 22 were topped with six inches of gravel only. A total of 60,000 cubic yards of sand and gravel were used to complete the project.

216-B-20 continued

History continued

The above ground transfer piping to the trenches was removed and each length of pipe was buried in a shallow trench, 3 to 4 feet deep, between trenches 216-B-29 and 216-B-53A. The pipe burial lays centerline north and south at approximate coordinates, N-36000, W-54800.

Since the renovation work done in 1969, the B-C trenches area has been relatively free from problems, excepting the blacktop surface over 216-B-28 trench has broken up. It is necessary to use herbicides on that trench to stop radioactive weed growth. In recent years, the entire radiation zone surface over all of the trenches, approximately 55 acres, has been treated every other year with Krovar herbicide. This has nearly eliminated the plant life, which is a food source for burrowing animals.

A strict surveillance program of frequent inspections must be maintained with respect to this liquid waste burial trenches area. The potential is great for further migration of radioactive materials from the site.

Note: See ARH-3088.

"A Preliminary Safety Analysis of The B-C Cribs Controlled Area"

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-8 Trench 216-B-21 Trench	216-B-21

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	9/56-10/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35540, W-54305 to N-35970, W-54055	H-2-3203 H-2-3204 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.67×10^6 liters. Scavenged waste from uranium recover (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction.
Deactivations: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	10	10.3
Beta, Ci	4.7×10^4	<1300.0
^{90}Sr, Ci	740	430.0
^{106}Ru, Ci	1.5×10^4	3.78×10^{-3}
^{137}Cs, Ci	370	224.0
^{60}Co, Ci	6.5	0.357
U, kg	680	675.0

Other Potential Hazards

Wind erosion of ground surface, radioactive weed growth, and burrowing animals.

Site Characterization Status and History

Refer to 216-B-20

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-9 Trench 216-B-22 Trench	216-B-22

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	10/56-10/56	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-35540, W-54420 to N-35970, W-54171	H-2-3203 H-2-3204 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft (1973) 10 ft (minimum)

Source and Description of Waste

4.74×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	2.6	2.60
Beta, Ci	9.5×10^4	<545.0
^{90}Sr, Ci	410	238.0
^{106}Ru, Ci	3.0×10^4	7.74×10^{-3}
^{137}Cs, Ci	45	27.1
^{60}Co, Ci	13	0.737
U, kg	420	418.0

Other Potential Hazards

Wind erosion of ground surface, radioactive weed growth and burrowing animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-10 Trench 216-B-23 Trench	216-B-23

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	10/56-10/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35300, W-54244 to N-35300, W-54744	H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.52×10^6 liters. Scavenged first-cycle waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction, Deactivation: Overground pipeline from the BC Crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	1.8	1.8
Beta, Ci	4.7×10^4	<307.0
^{90}Sr, Ci	150	84.4
^{106}Ru, Ci	1.5×10^4	3.85×10^{-3}
^{137}Cs, Ci	110	67.5
^{60}Co, Ci	6.7	0.368
U, kg	160	156.0

Other Potential Hazards

Wind erosion of ground surface, radioactive weed growth, and burrowing animals.

Site Characterization Status

Refer to 216-B-20

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-11 Trench 216-B-24 Trench	216-B-24

Location	Service Dates	Status
200 East, Outside - South Quadrant BC Crib Area, South of 200 East Area (across highway)	10/56-11/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35200, W-54244 to N-35200, W-54744	H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.7×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	7.7	7.70
Beta, Ci	7.3×10^4	<374.0
^{90}Sr, Ci	180	105.0
^{106}Ru, Ci	2.3×10^4	5.94×10^{-3}
^{137}Cs, Ci	130	77.8
^{60}Co, Ci	10	0.566
U, kg	250	246.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-12 Trench 216-B-24 Trench	216-B-25

Location	Service Dates	Status
200 East, Outside - South Quadrant BC Crib Area, South of 200 East Area (across highway)	11/56-12/56	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35100, W-54244 to N-35100, W-54744	H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

3.76×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	2.0	2.50
Beta, Ci	4.9×10^4	<2410.0
^{90}Sr, Ci	210	642.0
^{106}Ru, Ci	1.6×10^4	9.10×10^{-3}
^{137}Cs, Ci	56	580.0
^{60}Co, Ci	6.9	0.626
U, kg	150	588.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-12 Trench 216-B-24 Trench	216-B-26

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	12/56-2/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35000, W-54244 to N-35000, W-54744	H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

5.88×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U.- High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	2.5	2.50
Beta, Ci	7.7×10^4	<2410.0
^{90}Sr, Ci	1100	642.0
^{106}Ru, Ci	2.4×10^4	9.10×10^{-3}
^{137}Cs, Ci	950	580.0
^{60}Co, Ci	11	0.626
U, kg	590	588.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-14 Trench 216-B-27 Trench	216-B-27

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	2/57-4/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-34900, W-54244 to N-34900, W-54744	H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.42 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	0.70	0.7
Beta, Ci	5.5 x 10^4	<762.0
^{90}Sr, Ci	600	355.0
^{106}Ru, Ci	1.7 x 10^4	8.93 x 10^{-3}
^{137}Cs, Ci	34	21.0
^{60}Co, Ci	7.6	0.144
U, kg	340	300.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-14 Trench 216-B-28 Trench	216-B-28

Location	Service Dates	Status
200 East, Outside - South Quadrant BC Crib Area, South of 200 East Area (across highway)	4/57-6/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-34800, W-54244 to N-34800, W-54744	H-2-3232 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

5.05 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.6	5.6
Beta, Ci	1.7 x 10^4	<164.0
^{90}Sr, Ci	110	66.8
^{106}Ru, Ci	5200	2.67 x 10^{-3}
^{137}Cs, Ci	23	14.2
^{60}Co, Ci	2.3	0.144
U, kg	300	300.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20
This trench was covered with a blacktopping. It is in need of additional overfill to isolate the radioactivity that is near the ground surface.

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-16 Trench	216-B-29

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	6/57-7/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35972, W-54900 to N-35972, W-55400	H-2-3336 H-2-3337 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.84×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	1.1	1.1
Beta, Ci	5.1×10^4	<310.0
^{90}Sr, Ci	190	115.0
^{106}Ru, Ci	1.6×10^4	8.26×10^{-3}
^{137}Cs, Ci	59	36.4
^{60}Co, Ci	7.1	0.445
U, kg	340	344.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-17 Trench 216-B-30 Trench	216-B-30

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	7/57-7/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35847, W-54900 to N-35847, W-55400	H-2-3336 H-2-3337 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.78×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	2.1	2.1
Beta, Ci	1.6×10^4	<4710.0
^{90}Sr, Ci	600	358.0
^{106}Ru, Ci	3900	1.99×10^{-3}
^{137}Cs, Ci	3400	2080.0
^{60}Co, Ci	1.7	0.107
U, kg	88	88.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib	216-BC-18 Trench 216-B-31 Trench	216-B-31

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	7/57-8/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35722, W-54900 to N-35722, W-55400	H-2-3336 H-2-3337 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.74×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.2	5.2
Beta, Ci	1.9×10^4	<287.0
^{90}Sr, Ci	210	125.0
^{106}Ru, Ci	6100	3.12×10^{-3}
^{137}Cs, Ci	28	17.3
^{60}Co, Ci	2.7	0.169
U, kg	120	122.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-19 Trench 216-B-32 Trench	216-B-32

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	8/57-9/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35597, W-54900 to N-35597, W-55400	H-2-3336 H-2-3337 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.77×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	2.6	2.6
Beta, Ci	1.2×10^4	<456.0
^{90}Sr, Ci	260	152.0
^{106}Ru, Ci	3800	1.94×10^{-3}
^{137}Cs, Ci	130	77.7
^{60}Co, Ci	1.7	0.107
U, kg	11	11.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-20 Trench 216-B-33 Trench	216-B-33

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	9/57-10/57	Inactive

Site Coordinates(Approximate)	Reference Drawings	Elevations	
N-35472, W-54900 to N-35472, W-55400	H-2-3336 H-2-3337 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.74×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	12	11.8
Beta, Ci	1.0×10^4	< 374.0
^{90}Sr, Ci	41	24.5
^{106}Ru, Ci	3200	1.66×10^{-3}
^{137}Cs, Ci	270	168.0
^{60}Co, Ci	1.4	8.78×10^{-2}
U, kg	20	20.

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-BC-21 Trench	216-B-34

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway)	10/57-10/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35347, W-54900 to N-35347, W-55400	H-2-3336 H-2-3337 H-2-35020	Ground Water Table Site Depth	740 ft 405 ft(1973) 10 ft(minimum)

Source and Description of Waste

4.87 x 10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, 500 x 10 ft bottom surface. Trench construction. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.7	5.7
Beta, Ci	4400	< 70.0
^{90}Sr, Ci	41	24.5
^{106}Ru, Ci	1.4 x 10^3	7.07 x 10^{-4}
^{137}Cs, Ci	17	10.5
^{60}Co, Ci	0.60	3.76 x 10^{-2}
U, kg	85	85.0

Other Potential Hazards

Wind erosion of ground surface, Radioactive weed growth, and burrowing by animals.

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-B-52 Trench	216-B-52

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, South of 200 East Area (across highway).	12/57-1/58	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35415, W-54170 to N-35415, W-54750	H-2-3336 H-2-35020	Ground Water Table Site Depth	731 ft 405 ft(1973) 8 ft(minimum)

Source and Description of Waste

8.53×10^6 liters. Scavenged waste from uranium recovery (TBP solvent extraction) process in 221-U. High-salt, neutral/basic.

Description of Facility

One crib, trench structure, 580 ft x 10 ft bottom surface. Deactivation: Overground pipeline from the BC crib line to the BC trenches was removed and the trench backfilled when it reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	19	19.0
Beta, Ci	1.8×10^4	< 421.0
^{90}Sr, Ci	11	6.65
^{106}Ru, Ci	8600	6.61×10^{-3}
^{137}Cs, Ci	340	212.0
^{60}Co, Ci	4.5	0.303
U, kg	30	29.9

Site Characterization Status

Refer to 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (Class IB-Transuranic Disposal)	216-B-53A Trench	216-B-53A

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway).	10/65-11/65	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-35972, W-54690 to N-35972, W-54750	H-2-3336 H-2-35020	Ground Water Table Site Depth	743 ft 404 ft(1973) 8 ft(minimum)

Source and Description of Waste

5.49×10^5 liters of neutral-basic waste from 300 Area operations of the Hanford Laboratories.

Description of Facility

Trench, 60 x 10 ft bottom surface area. Used on specific retention basis until its capacity was reached. The overground piping to the trench was removed and the trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	100	100.0
Beta, Ci	50	< 0.502
^{90}Sr, Ci	<0.10	< 7.27×10^{-2}
^{106}Ru, Ci	5.0	6.38×10^{-4}
^{137}Cs, Ci	<0.10	< 7.41×10^{-2}
^{60}Co, Ci	0.50	9.01×10^{-2}
U, kg	23	22.7

History

See 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-B-53 Trench 216-B-53B Trench	216-B-53B

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway).	11/62-3/63	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35916, W-54723 to N-35937, W-54583	H-2-3336 H-2-35020	Ground Water Table Site Depth	734 ft 405 ft(1973) 8 ft(minimum

Source and Description of Waste

1.51×10^4 liters. Hanford Laboratories Operations wastes from 300 Area. Low-salt, neutral/basic.

Description of Facility

One crib, trench structure, 150 ft x 10 ft bottom surface. Deactivation: Overground piping removed, the trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.0	5.0
Beta, Ci	44	< 23.2
^{90}Sr, Ci	10	6.83
^{106}Ru, Ci	4.0	9.65×10^{-5}
^{137}Cs, Ci	7.0	4.91
^{60}Co, Ci	1.0	0.13
U, kg	9.1	9.07

History

See 216-B-20

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-B-54 Trench	216-B-54

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway).	3/63-10/65	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35772, W-54550 to N-35772, W-54750	H-2-3336 H-2-35020	Ground Water Table Site Depth	734 ft 405 ft(1973) 8 ft(minimum)

Source and Description of Waste

9.99×10^5 liters. Hanford Laboratories wastes from 300 Area. Low-salt, neutral/basic.

Description of Facility

One crib, trench structure, 200 ft x 10 ft bottom surface. Deactivation: Overground piping was removed and the trench backfilled when the trench reached its specific retention capacity.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.0	5.0
Beta, Ci	2400	< 6.28
^{90}Sr, Ci	0.10	7.09×10^{-2}
^{106}Ru, Ci	10	7.36×10^{-4}
^{137}Cs, Ci	0.10	7.25×10^{-2}
^{60}Co, Ci	0.10	1.59×10^{-2}
U, kg	9.1	9.07

History

See 216-B-20

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Crib (covered trench)	216-B-59 Crib 216-B-58 Trench	216-B-58

Location	Service Dates	Status
200 East, Outside-South Quadrant BC Crib Area, south of 200 East Area (across highway).	11/65-6/67	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35672, W-54550 to N-35672, W-54750	H-2-3336 H-2-33400	Ground Water Table Site Depth	734 ft 405 ft(1973) 8 ft(minimum)

Source and Description of Waste

4.13×10^5 liters. Battelle Northwest Laboratory waste from 300 Area. Low-salt, neutral/basic.

Description of Facility

One crib, trench structure, 200 ft x 10 ft bottom surface.
Deactivation: Overground piping removed, trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	6.7	6.7
Beta, Ci	59	< 26.7
^{90}Sr, Ci	10	7.50
^{106}Ru, Ci	7	2.20×10^{-3}
^{137}Cs, Ci	7.7	5.84
^{60}Co, Ci	2.4	0.530
U, kg	9.1	9.12

Other Potential Hazards

Wind erosion of ground surface, radioactive weed growth and burrowing by animals.

History

See 216-B-20

Name/Type of Facility	Past Designation	Number
Ground Surface Contamination	B-C Cribs Controlled Area	UN-216-E-11

Location	Service Dates	Status
200, East, Outside, South Quadrant A ground surface area approximately 2 miles square adjacent to and directly south of the 200 East Area.	*May 1958	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations
township 12 north, range 26-E sections 10,11,13,14,22,23.		Ground Level approx. 740 ft Water Table (1973) 405 ft

Source and Description of Waste * In May of 1958, radioactive rabbit and coyote dung were found scattered over the ground surface of the desert south, east, and west of the BC trenches area. It is postulated that a badger or some other animal burrowed into the 216-B-23 backfilled trench and exposed a radioactive salt layer. Rabbits then ingested the contaminated salts and defecated over approximately four square miles undisturbed sagebrush land depositing animal feces on the ground.

Description of Facility

Sagebrush and cheatgrass covered rangeland with surface contamination from scattered animal feces.

Radionuclide Content (Calculated from ARMS Survey)

14 curies	Cesium 137
81 curies	Strontium 90

History:

Approximately 2,000 acres of land south of the 200 East Area in the center of the Hanford Reservation is contaminated with an estimated 14 cuires of ^{137}Cs and ^{90}Sr associated with animal wastes. Approximately half of this activity is located on (or within) 2.5 centimeters of the ground surface. The source of the contamination was the B-C Cribs and trenches which were used as liquid radioactive waste disposal sites during the 1950's. The mechanism for movement of radionuclides from the disposal site to the ground surface is believed to have been burrowing by an animal (probably a badger) followed by use of the exposed material as a salt lick by rabbits and other animals. Although the exact time is unknown, the burrowing is believed to have occurred about 1958. When the radioactivity was discovered, the burrow was sealed, the contaminated site was classed as a radiation zone, and surveillance initiated.

UN-216-E-11 continued

History

In 1973, ten and one half miles of firebreak roads were constructed through the area to permit easy access in case of fire.

Monthly and quarterly surveillance reports during the past five years indicate the contamination to be fixed beneath a good growth of vegetation. There is no significant evidence of resuspension of the radioactive particulate matter.

Reference Document - ARH-3088, "A Preliminary Safety Analysis of the B-C Cribs Controlled Area"

VOLUME III 200 NORTH QUADRANT (200 N)

Waste Disposal Sites and Associated Radiation Zones

Quadrant Boundaries - All of the 200 North Area.

See Quadrant maps at the end of this section.

How to read the Index and locate a site:

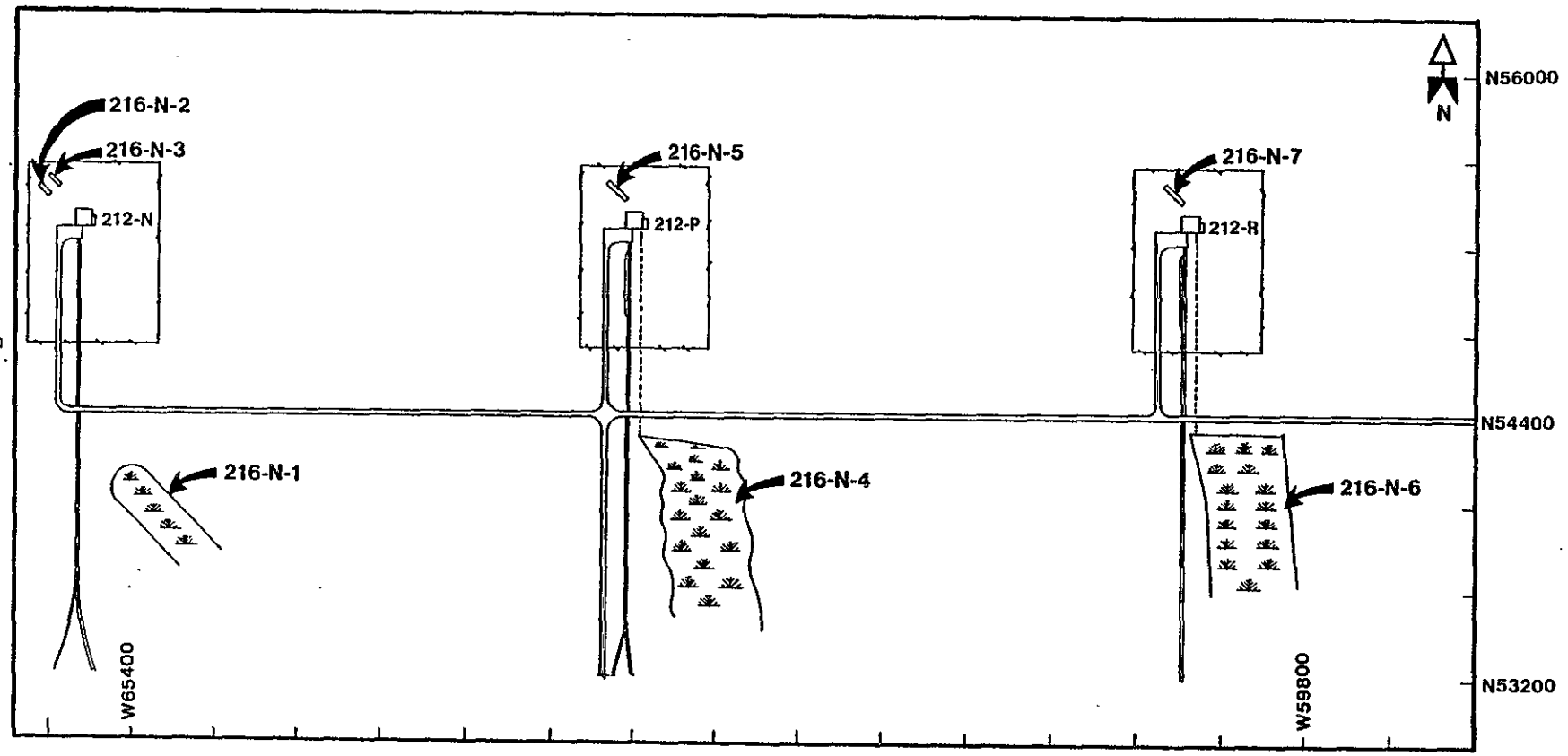
Example - 216-N-1 Pond

Site Number	Volume	Quadrant
216-N-1 Pond	III.	200 N

VOLUME III GABLE MOUNTAIN QUADRANT (GABLE MTN.)

Waste Storage Sites

Quadrant Boundaries - Gable Mountain Vaults Area Only.


216-N-2
216-N-3
212-N
216-N-5
212-P
216-N-7
212-R
N
N56000
N54400
N53200
216-N-1
216-N-4
216-N-6
W65400
W59800

RHO-CD-673

INDEX - VOLUME III OUTSIDE 200 EAST AREA

200 North and Gable Mountain Quadrant

Name/Type of Facility	Past Designation	Number
Pond	212-N Swamp 216-N-1 Swamp	216-N-1

Location	Service Dates	Status
200 North Area	9/44 to 6/52	Removed from radiation zone status.

Site Coordinates	Reference Drawings	Elevations	
N-53700, W-65050 N-54125, W-65475	H-2-32524	Ground Water Table Site Depth	~580 ft 442 ft(1973) Surface

Source and Description of Waste

Waste volume unknown. Basin overflow from the 212-N Building.

Description of Facility

Pond measuring 500 x 100 ft.

Radionuclide Content (calculated from discharge data)

Removed from radiation zone status.

History:

A six-foot deep trench was cut across the bottom of this covered pond area near the head end of the pond. No detectable radioactive soils or vegetation was found in the excavation. All posts, chains, and signs were removed. The site is no longer a radiation zone.

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Trench	216-N-1 Trench 216-N-2 Trench	216-N-2

Location	Service Dates	Status
200-North Area, 300 ft north of 212-N	3/47-4/47	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-55485, W-65788	H-2-32524	Ground	578 ft
		Water Table	430 ft (1973)
		Site Depth	6 ft

Source and Description of Waste

7.57×10^6 liters. Basin water and sludge cleanout waste from 212-N.

Description of Facility

Trench, 50 ft x 10 ft bottom dimension.
Deactivation: Overground piping removed and trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	none	none
Beta, Ci	10	<0.387
^{90}Sr, Ci	<0.20	9.28×10^{-2}
^{106}Ru, Ci	<0.43	2.21×10^{-12}
^{137}Cs, Ci	<0.21	0.104
^{60}Co, Ci	none	none
U, kg	none	none

History:

No radioactive problems have developed at this site.

Name/Type of Facility	Past Designation	Number
Trench	212-N-2 Trench 212-N-3 Trench	216-N-3

Location	Service Dates	Status
200 North Area, 300 ft north of 212-N	5/52-6/52	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-55455, W-65838	H-2-32524	Ground	578 ft
		Water Table	430 ft (1973)
		Site Depth	6 ft

Source and Description of Waste

7.57×10^6 liters. Basin water and sludge cleanout waste from 212-N.

Description of Facility

Trench, 50 ft x 20 ft bottom dimension.
Deactivation: Overground piping removed and trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	none	none
Beta, Ci	<10	<0.437
^{90}Sr, Ci	<0.20	0.105
^{106}Ru, Ci	<0.43	6.97×10^{-9}
^{137}Cs, Ci	<0.21	0.117
^{60}Co, Ci	none	none
U, kg	none	none

History:

No surface contamination has been detected at this site since start up, to date.

Name/Type of Facility	Past Designation	Number
Pond	212-P Swamp 212-N-4 Swamp	216-N-4

Location	Service Dates	Status
200 North Area, 900 ft south of 212-P	9/44-6/52	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-53400, W-62600 N-54300, W-62700	H-2-32524	Ground Water Table Site Depth	558 ft 430 ft (1973) 0 (surface)

Source and Description of Waste

9.46×10^8 liters. Basin overflow waste from 212-P.

Description of Facility

Pond, 500 ft x 200 ft bottom dimension.
Deactivation: Inlet valving to 212-P basin closed and locked.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge
Pu, g	1
Beta, Ci	10
^{90}Sr, Ci	0.20
^{106}Ru, Ci	0.43
^{137}Cs, Ci	0.21
^{60}Co, Ci	none
U, kg	4.5

History:

In February 1973, two four-foot deep trenches were cut across the covered pond. Soil contamination to a maximum of 1000 c/m was detected near the bottom of the cut.

Name/Type of Facility	Past Designation	Number
Trench	212-P-Trench 216-N-5 Trench	216-N-5

Location	Service Dates	Status
200 North Area, 100 ft north of 212-P	5/52-6/52	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-55408, W-63130 to N-55495, W-63225	H-2-32524	Ground	575 ft
		Water Table	430 ft (1973)
		Site Depth	6 ft

Source and Description of Waste

7.57×10^6 liters. Basin water and sludge cleanout waste from 212-P.

Description of Facility

Trench, 80 ft x 15 ft bottom dimension.
Deactivation: Overground piping removed and trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	none	none
Beta, Ci,	<10	<0.437
^{90}Sr, Ci	<0.20	0.105
^{106}Ru, Ci	<0.43	6.97×10^{-9}
^{137}Cs, Ci	<0.21	0.117
^{60}Co, Ci	none	none
U, kg	none	none

History:

No observed problems with this covered trench.

Name/Type of Facility	Past Designation	Number
Pond	212-R Swamp 216-N-6 Swamp	216-N-6

Location	Service Dates	Status
200 North Area, 900 ft south of 212-R.	9/44-6/52	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-53600, W-60030 N-54350, W-60115	H-2-32524	Ground Water Table Site Depth	557 ft 430 ft(1973) 0 (surface)

Source and Description of Waste

9.46×10^8 liters. Basin overflow waste from 212-R.

Description of Facility

Pond, 500 ft x 150 ft bottom dimension.
Deactivation: Inlet water valving to 212-R basin closed and logged.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge
Pu, g	1
Beta, Ci	10
^{90}Sr, Ci	0.20
^{106}Ru, Ci	0.43
^{137}Cs, Ci	0.21
^{60}Co, Ci	none
U, kg	4.5

History:

A four-foot deep cut was made across the 216-N-6 covered pond site in February 1973. Radioactivity to a maximum of 4,000 c/m was detected in the soil of the excavation.

Name/Type of Facility	Past Designation	Number
Trench	212-R Trench 216-N-7 Trench	216-N-7

Location	Service Dates	Status
200 North, 100 ft north of 212-R	5/52-6/52	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-55399, W-60505 to N-55482, W-60605	H-2-32524	Ground	571 ft
		Water Table	430 ft (1973)
		Site Depth	6 ft

Source and Description of Waste

7.57×10^6 liters. Basin water and sludge cleanout waste from 212-R.

Description of Facility

Trench, 80 ft x 15 ft bottom dimension.
Deactivation: Overground piping removed and trench backfilled.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	none	none
Beta, Ci	<10	<0.437
^{90}Sr, Ci	<0.20	0.105
^{106}Ru, Ci	<0.43	6.97×10^{-9}
^{137}Cs, Ci	<0.21	0.117
^{60}Co, Ci	none	none
U, kg	none	none

History:

No radioactive problems have been observed at this site.

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Storage Vaults	Gable Mtn. Pu storage vaults	213-J & K

Location	Service Dates	Status
200 East, Outside-South side Gable Mtn. East of Gable Mtn. Pond.	1945-present	Active

Site Coordinates (Approximate)	Reference Drawings	Elevations

Source and Description of Waste

Sodium bearing equipment and materials.

Description of Facility

Concrete lined storage vaults.

Radionuclide Content (calculated from discharge data)

1. Vault 213-J contains cans of soil samples from various locations in the United States. All samples are nonradioactive.
2. Vault 213-K contains packages of equipment contaminated with radioactive sodium. General background readings in the vault, 2/14/78, ranged from 2 to 5 mR/hr. No smearable radioactivity was detected on any of the surfaces inside the vaults.

Subject: RADIATION MONITORING MONTHLY ACTIVITY REPORT - NOVEMBER 1974

Site Cleanup

On November 11, 1974 excavations were made to uncover the 213-J and 213-K cribs designated as radioactive liquid waste disposal sites in the Gable Mountain Vault Area. A thorough radiation survey of the inlet piping and crib gravel beds did not reveal any radioactivity. Rust scale taken from the interior of the piping was analyzed and found to be free of radioactivity above that of world fallout. Radioactive markings were obliterated and both cribs were removed from "Radiation Zone" status.

Date: February 3, 1975

To: T. E. Sparks

From: R. M. Smithers

Subject: LANDLORD RESPONSIBILITY - 213-J AND 213-K VAULTS ON GABLE MOUNTAIN

References:
(1) Letter, November 6, 1974, H. D. Smith to G. T. Stocking, "213-J and 213-K Gable Mountain Vaults"

(2) Letter, November 15, 1974, H. L. Maxfield to B. J. Saueressig, "Inspection Of The 213-J and 213-K Gable Mountain Vaults Radioactive Liquid Waste Disposal Sites"

(3) Letter, January 24, 1975, T. E. Sparks to B. L. Vail, "Landlord Responsibility - 213-J And 213-K Vaults On Gable Mountain"

Reference 3 describes assignment of responsibility for the 213-J and 213-K vaults on the south side of Gable Mountain to R. M. Smithers and J. A. Teal. It is our understanding that the facility comes into our custody in an as-is condition and that Battelle Northwest Laboratory and Hanford Engineering Development Laboratory plan to continue to use the vaults for storage of hazardous materials.

We believe that our interests should be protected to the extent that we do not incur unexpected expenses for upgrading the facility, its appurtenances and services, and that responsibilities in the event of emergency conditions and accidents involving the facilities should be clearly defined.

Documentation of present condition of the vaults and identification of the minimum upgrading required for continued use should be made. This should cover roadway and parking areas, fencing, electrical services, ventilation equipment, security features, fire protection equipment, communications' gear, surveillance services, etc.

Modification of the Hanford Services and Facilities catalog to record Administration and Atlantic Richfield Hanford Company agreements on responsibilities would appear appropriate. Accomplishment of a suitable lease agreement between ARHCO and the tenants should be made to record understandings for occupancy by BNW and HEDL.

We request that you assist us by arranging for coordination of the transfer to avoid an interim period of high risks for us.

JAT:RMS:jm

cc: GE Backman
G Burton, Jr.
J Faulhaber
HO Monson

Atlantic Richfield Hanford Company
Federal Building
Richland, Washington 99352
Telephone 509 942 7411

RHO-CD-673

FEB 2 7 1975

Battelle Memorial Institute
Pacific Northwest Laboratory
Attention: Messrs. L. M. Ostby
D. L. Weaver

Westinghouse Hanford Company
Attention: Messrs. F. W. Grubb
Z. B. Rose

Subject: GABLE MOUNTAIN VAULTS - 213 J AND 213 K

Dear Mr. Rose:

Transfer is effected by the attached Inter-contractor Transfer order. Routine expense to Atlantic Richfield Hanford Company is not anticipated by your planned usage of the buildings. No rental will be charged; however, you will be expected to issue work orders to ARHCO for fence repair and weed removal as needed and for any significant building repair.

Very truly yours,

ORIGINAL SIGNED BY
R. M. SMITHERS

R. M. Smithers
Manager - Tank Farm Management

RMS:JDM:tb

Att.

bcc. FL LOWDEFINER w/o/ATT
HL MAXFIELD ✓ "
HI SHEPARD "

RHO-CD-673

Battelle
Pacific Northwest Laboratories

Project Number

Internal Distribution

Date November 13, 1974

To H. Maxfield

From Ray Wildung

Subject USE OF GABLE MOUNTAIN VAULT

We are presently using the Gable Mountain Vault (213J) to store 80 to 100 kilogram quantities of 35 soils. These uncontaminated soils are being periodically subsampled for use on a long-term (3-5 year) study of the fate and effects of plutonium in soils and plants.

mmg

VOLUME III SOUTH OF 200 WEST AREA QUADRANT (S-200 W)

Waste Disposal Sites and Associated Radiation Zones

Quadrant Boundaries

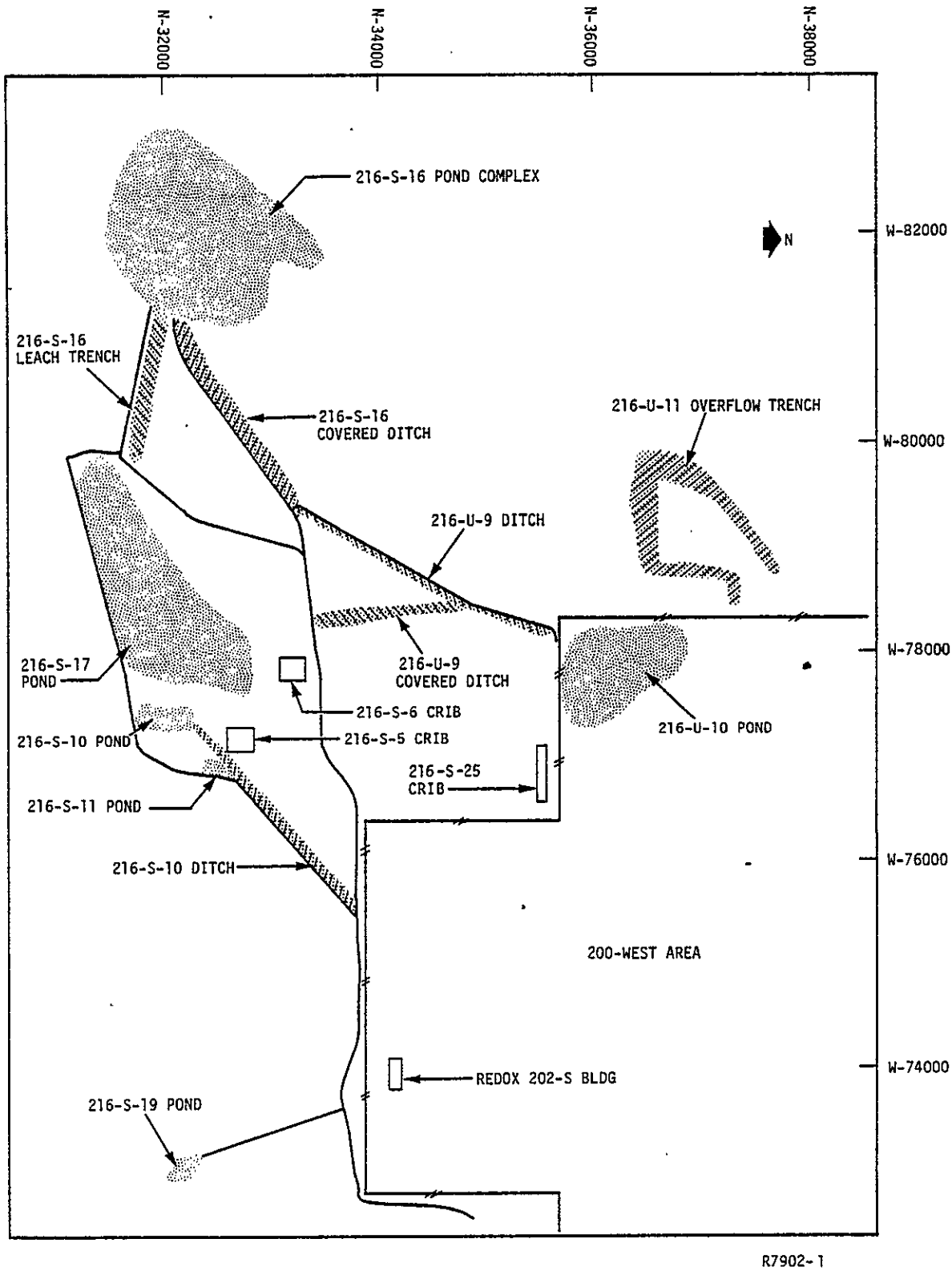
East Boundary	-	Extension to the south of the 200 West Area east fenceline to a point beyond the 216-S-19 Pond.
South Boundary	-	To include the 216-S-19 Pond and the 216-S-17 Pond.
West Boundary	-	To include the 216-S-16 Pond Complex.
North Boundary	-	South fenceline of 200 West Area, then north to include the 216-U-11 Overflow Trench.

See Quadrant maps at the end of this section.

How to read the Index and locate a site:

Example - 216-S-5 Crib

Site Number	Volume	Quadrant
216-S-5 Crib	III.	S-200 W


N-32000
N-34000
N-36000
N-38000
W-82000
W-80000
W-78000
W-76000
W-74000
N
216-S-16 POND COMPLEX
216-S-16
LEACH TRENCH
216-S-16
COVERED DITCH
216-U-11 OVERFLOW TRENCH
216-U-9 DITCH
216-U-9
COVERED DITCH
216-S-17
POND
216-S-6 CRIB
216-S-5 CRIB
216-S-10 POND
216-S-25
CRIB
216-U-10 POND
216-S-11 POND
216-S-10 DITCH
200-WEST AREA
REDOX 202-S BLDG
216-S-19 POND
R7902-1

INDEX - VOLUME III OUTSIDE 200 WEST AREA

South Quadrant

Name/Type of Facility	Past Designation	Number
Crib	216-S-5 Cavern #1 216-S-9 216-S-6 Crib	216-S-5

Location	Service Dates	Status
Outside, 200 West, South Quadrant 3000 ft southwest of 207-S Retention Basin. Near and west of the 216-S-10 Ditch.	3/54-3/57	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-32704, W-77000 (center)	H-2-5963 H-2-5962	Ground Water Table Site Depth	651 ft 470 ft(1973) 15 ft

Source and Description of Waste

4.1×10^9 liters. Process vessel cooling water and steam condensate from 202-S. Acidic.

Description of Facility

One gravel crib, bottom surface 210 ft x 210 ft. Deactivation: Pipeline to crib valved out and locked.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	5.8×10^2	5.8×10^2
Beta, Ci	9.6×10^2	$<2.14 \times 10^2$
^{90}Sr, Ci	1.3×10^2	7.31×10^1
^{106}Ru, Ci	30.0	3.34×10^{-6}
^{137}Cs, Ci	60.0	3.50×10^1
^{60}Co, Ci	< 0.100	$<4.22 \times 10^{-3}$
U, kg	2.7×10^2	2.72×10^2

History:

See next page.

216-S-5 continued

History:

The 216-S-5 Crib (originally called an underground swamp) was built as a replacement for the grossly contaminated 216-S-17 Pond. Its function was to receive process vessel cooling water and steam condensate from the 202-S Building.

The following historical excerpts were taken from the Redox Radiation Monitoring Monthly Reports.

May 1954

"After approximately two months use, the new underground swamp is operating at a liquid level approximately twice that expected with seven foot maximum head capacity, the water level raised to approximately 6.5 feet. An emergency trench and connecting ditch was dug adjacent to the underground swamp, to be used if the water level should approach the maximum capacity. A project proposal has been started to build a second underground swamp. Process samples taken after the H-4 coil leak was detected indicated the stream activity to be 1.0×10^{-3} μc/cc."

May 1956

"Cooling water discharge rates made it necessary to cut a hole along the top edge of the 216-S-5 crib in order to prevent flooding, and to discharge overflow cooling water onto the ground immediately southwest of 216-S-5. The overflow rates were estimated to be 50 to 100 gpm, representing an estimated 5% maximum of the total flow into the 216-S-5 Crib. The flow into the 216-S-6 crib is being controlled to prevent flooding and possible damage. Overflow water sample analyses showed that gross beta emitter concentrations in the 10^{-5} μc/cc order of magnitude are being discharged to the surface disposal area.

This emergency overflow problem will continue through the summer, probably at an increasing rate, until the cooling water segregation project can be completed. Earliest completion estimates indicate that the problem may last until October, providing construction can start work on the project soon.

This method of surface disposal at Redox invites problems comparable to the old Redox swamp days, and the utmost concern must be placed on failing concentrations to avoid high activity discharges to a surface site during the coming months."

216-S-5 continued

History:

June 1956

"Cooling water disposal to the surface site southwest of 216-S-5 Crib was curtailed some this month due to the 202-S Building shutdown. residue remaining in the disposal area was contaminated up to 50,000 c/m with general levels of 10,000 c/m. The dried area was watched closely for any spread due to wind, and by the end of the month some water was flowing into this area; thereby lessening the contamination spread potential."

September 1956

"Ground contamination increased significantly during the month at the 216-S-5 Crib overflow pond when the A-2 dissolver and H-4 coils failed. Contamination levels increased from an average 50 to 100 mrads/hr along the pond edge to an average 350 mrads/hr and maximum spots up to 17 rads/hr."

Note:

In November of 1954, part of the water previously going into the 216-S-5 Crib (water from vessels of greater leak potential in the 202-S Building) was segregated and sent to the newly constructed 216-S-6 Crib. The 216-S-5 Crib and companion overflow pond were continued in use until the construction of the 216-S-16 Pond complex in September of 1957.

March 1974

"Radiation Monitoring personnel assisted with a detailed radiation survey and inspection of 70 low-level radiation liquid waste disposal cribs throughout the 200 Areas. The primary purpose of the survey was to determine the physical appearance of each crib with respect to cave-in or cave-in potential as a hazard to man and the environs. Action taken as a result of the survey was to fill in 4 cave-ins in the 216-S-5 Crib zone, and one 5 feet deep cave-in over the 216-B-18 Crib. No surface contamination was detected within any of the crib zone perimeters."

Name/Type of Facility	Past Designation	Number
Crib	216-S-6 Cavern #2 216-S-13 216-S-5 Crib	216-S-6

Location	Service Dates	Status
Outside-200 West, South Quadrant 3648 ft southwest of 202-S 2375 ft south of 10th Street West and north of 216-S-5 Crib.	11/54-7/72	Inactive

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-33250, W-77850 (center)	H-2-2594 H-2-2595	Ground Water Table Site Depth	651 ft 471 ft (1973) 15 ft

Source and Description of Waste

4.5×10^9 liters. Redox steam condensate. Low salt, neutral/basic.

Description of Facility

Crib, gravel-filled. 210 ft x 210 ft bottom dimension.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	4.7×10^2	4.73×10^2
Beta, Ci	5.3×10^2	$<8.49 \times 10^2$
^{90}Sr, Ci	4.1×10^2	2.76×10^2
^{106}Ru, Ci	1.3×10^2	2.76×10^{-2}
^{137}Cs, Ci	2.1×10^2	1.53×10^2
^{60}Co, Ci	2.9×10^0	<0.69
U, kg	2.7×10^2	2.72×10^2

History:

This crib was constructed as part of the Segregation Project for the segregation of "high potential" from "low potential" radioactive contaminated condensates and cooling water. The "high potential" was sent to the 216-S-6 Crib and the "low potential" to the 216-S-5 Crib. The 216-S-6 Crib was first put into use in November of 1954.

216-S-6 continued

History:

From the Redox Radiation Monitoring Monthly Report we read the following:

September 1955

"The 216-S-5 and 216-S-6 cooling water cribs operated at greater than capacity most of the month, and some grade level seepage was observed. Temporary relief was provided by blading a small corner off of the 216-S-6 Crib and providing a run off ditch area, rather than allow the cavern water to seep through the roof and damage the roof seal. No water has overflowed to this relief area, and no contamination problems were measured in the seepage areas."

The crib has not been used since July 1972.

Name/Type of Facility	Past Designation	Number
Ditch and Pond	202-S Chemical Sump #1 and Ditch Chemical Sewer Trench	216-S-10

Location	Service Dates	Status
200 West - Outside, South Quadrant Ditch begins 1463 ft southwest of 202-S, 133 ft south of 10th Street. Pond ends 4351 ft southwest of 202-S.	2/54-5/54	The ditch is still active.

Site Coordinates (Approximate)	Reference Drawings	Elevations
N-33800, W-75421 N-31900, W-77200 (center)	H-2-32525	Ground 651 ft Water Table 471 ft (1973) Site Depth Pond, 0 ft.; Ditch, 6 ft.

Source and Description of Waste

2×10^6 liters. Chemical sewer waste from 202-S; overflow from high water tower.

Description of Facility

Ditch, 2250 ft x 6 ft bottom dimension.

Pond, 5 acres. (This includes the four finger leach trenches.)

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	< 0.10	< 0.10
Beta, Ci	24.0	< 2.21
^{90}Sr, Ci	1.0	0.55
^{106}Ru, Ci	10.0	6.46×10^{-7}
^{137}Cs, Ci	1.0	0.57
^{60}Co, Ci	None	None
U, kg	2.3	2.27

History:

See next page.

216-S-10 continued

History:

The 216-S-10 Ditch received chemical sewer waste water from the time of startup of the Redox plant, August 1951. Early in 1954 it became apparent more leaching surface was needed, so in February 1954 the (Four-fingers) leaching ponds were dug off the southwest end of the 216-S-10 Ditch. By May 1954 the 216-S-10 disposal system was swamped again with water, necessitating the digging of the two 216-S-11 leach ponds on the southeast side of the 216-S-10 Ditch. An additional problem was the presence of radioactivity in the ditch from contaminated floor and sewer drains within the 202-S Building.

An item from the Redox Radiation Monitoring Monthly Report, May 1954 reads:

> "A follow up survey of the chemical sewer south of 200-West Area showed the trench to be contaminated up to 800 mrads/hr in 500 mr/hr in spots, with lower contamination levels up to 80,000 c/m in an overflow area approximately one acre in area, which resulted from a breakthrough on the east trench earth fill. The area was roped off until further disposition of the contaminated area could be determined."

The reference breakthrough occurred in the newly made southeast dike of the south 216-S-11 Pond.

The contaminated areas were subsequently decontaminated.

An item pertinent to the management of the 216-S-10 Liquid Waste Disposal system occurred in the Redox Radiation Monitoring Monthly Report, September 1954:

> "Inadvertent dumping of ANN solution to the chemical sewer has seriously plugged soil at the terminus of this stream. The liquid level increased significantly currently every effort is being made in the building to cut down on the water to this stream. The contamination levels, up to 500 mrads/hr along the ditch has not changed."

The 216-S-10 Ditch, but not the ponds, still receives a small amount of waste water from the air conditioning water scrubbed filters in the 202-S Building. It is not radioactive. A number of excavations by backhoe across the 216-S-10 Ditch in 1971 showed it to be free of contamination.

Radiation Survey

The only radioactivity found in the ditch and ponds during the March 1, 1979 inspection was associated with Russian Thisle that had blown into the ditch and ponds from the nearby 216-S-17 covered pond. The radioactivity ranged to a maximum of 2000 c/m beta-gamma activity.

NOTE: During the summer of 1955, two feet of "muck" was dredged from the bottom of the 216-S-10 Ditch to improve water percolation in the ditch. The contaminated "muck" was buried in scooped out holes along the sides of the ditch. The depth and location of each burial site is unknown.

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Ponds	202-S Chemical Sump #2 and Chemical Sewer Trench. 216-S-11 Swamp	216-S-11

Location	Service Dates	Status
Outside-200 West, South Starts 3135 ft southwest of 202-S Southeast of the lower end of the 216-S-10 Ditch.	5/54-8/65	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-32000, W-76900 Center #2 N-32450, W-76725 Center #1	H-2-5962 H-2-2430 H-2-34762	Ground Water Table Site Depth	651 ft 471 ft(1973) 0

Source and Description of Waste

3.22×10^9 liters. Waste from air conditioning and drain in 202-S.

Description of Facility

1.5 acres.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	< 0.23	< 0.274
Beta, Ci	1.0×10^2	< 2.99
^{90}Sr, Ci	1.1	< 0.73
^{106}Ru, Ci	10.	$< 4.59 \times 10^{-4}$
^{137}Cs, Ci	1.1	< 0.75
^{60}Co, Ci	< 0.13	$< 3.12 \times 10^{-2}$
U, kg	<27.0	$< 3.61 \times 10^{1}$

History:

The two 216-S-11 small ponds were dug in May of 1954 to give additional leaching surface for the disposal of water from the 216-S-10 Ditch. The pond inlets from the ditch were cut somewhat above the level of the 216-S-10 Ditch bottom so that the 216-S-11 Ponds would become dry whenever the water in the 216-S-10 Ditch receded, and would fill again when ever the S-10 Ditch water level raised. The ponds were in use until August of 1965. Since that date, the S-10 Ditch water level has not been high enough to overflow into the ponds. The south pond was covered in the summer of 1975.

216-S-11 continued

History:

An item of interest from the Redox Radiation Monitoring Monthly Report, May 1954 reads:

> "A follow up survey of the chemical sewer south of 200 West Area showed the trench to be contaminated up to 800 mrads/hr in 500 mr/hr in spots, with lower contamination levels up to 80,000 c/m in an overflow area approximately one acre in area, which resulted from a breakthrough on the east trench earth fill. The area was roped off until further disposition of the contaminated area could be determined."

The reference breakthrough occurred in the newly made southeast dike of the south 216-S-11 Pond.

The contaminated areas were subsequently decontaminated.

NOTE: The 216-S-11 south pond area is presently being used as a root depth penetration study site. It is free from radioactive contamination.

Name/Type of Facility	Past Designation	Number
Trench	Cold organic trench or grave 216-S-4 Burial Contaminated Hexane	216-S-14

Location	Service Dates	Status
200 West, Outside (south) Quadrant 1273 ft south of 202-S Building.	12/51-1/52 Released 2/71	Released from Radiation Zone Status

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-33100, W-73800	M2 600 W Sk 27	Ground Water Table Site Depth	670 ft 462 ft (1973) 6 ft

Source and Description of Waste

Volume not known. Redox Plant start-up organic waste.

Description of Facility

Trench, 100 ft x 8 ft.
Deactivation: Above ground piping removed and trench backfilled.

Radionuclide Content (calculated from discharge data)

Not known. Low-level contamination assumed.

History: Core drillings were made of this site during February of 1971. There was a strong odor of hexone from each of the sample cores and the core holes, but no radioactivity was found. The site was released from a radiation zone status February 1971.

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Pond and Ditch	202-S Swamp and Ditch 202-S Swamp #1 Redox Pond #2	216-S-16

Location	Service Dates	Status
Outside-200 West, South Quadrant Ditch starts 5472 ft southwest of 202-S and 2736 ft southwest of extreme southwest corner of 200-W Area perimeter fence	9/57-	Active

Site Coordinates	Reference Drawings	Elevations	
N-31600, W-81140 N-32920, W-82180 N-32920, W-80900 N-31600, W-80900	H-2-30264 H-2-46019 H-6-362	Ground Water Table Site Depth	651 ft 471 ft(1973) 6 ft

Source and Description of Waste

4.07×10^{10} liters. Process cooling water from 202-S.

Description of Facility

Ditch, 1700 ft x 4 ft
Pond, 31 acres.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	3.7×10^{2}	3.68×10^{2}
Beta, Ci	1.8×10^{3}	$<2.00 \times 10^{2}$
^{90}Sr, Ci	<92	$<6.10 \times 10^{2}$
^{106}Ru, Ci	2.2×10^{2}	2.09×10^{-2}
^{137}Cs, Ci	58.	3.97×10^{1}
^{60}Co, Ci	<5.9	<1.45
U, kg	3.2×10^{3}	3.16×10^{3}

History:

See following pages.

216-S-16 continued

History:

The first pond, Pond #1 was completed in 1957 and waters previously sent into the 216-S-5 crib were diverted to the newly dug 216-S-16 Pond. The site was soon enlarged to include overflow pond #2 into which the #1 Pond overflowed at the southeast edge of the #1 Pond. A third pond was constructed to receive the overflow from the #2 Pond. The #2 Pond and the #3 Pond were so constructed as to wrap around the south and southwest bank of the #1 Pond. A leach trench approximately ten feet deep and 1100 feet long was dug due east of the #2 Pond Inlet to help take care of the excess water.

In 1965 it was deemed necessary to construct a wrap around emergency pond and dike around the south, west, and north sides of the 216-S-16 Redox Ponds complex to preclude the possibility of contaminated water breaching the dikes and reaching the public highway to the west. This #4 Pond was never used. It remains free from radioactive contamination.

These were a number of incidents during the years of operation that brought radioactive contamination to the site. These have been taken from Redox Radiation Monitoring Monthly Reports and are listed as follows:

In June, 1958, and again in April, 1959, a break occurred in the Redox cooling water swamp dike. The resultant spill effected an area approximately 150 yards from the dike in a westerly direction and 300 yards north and south. The ground was contaminated to a maximum of 750 m-rads/hr. Following repairs to the dike, the contaminated ground area was bladed under and Underground Contamination signs posted.

September, 1965

"A failure of the F-1 cooling coil permitted radioactive solution to enter the cooling water stream and flow to the Redox Pond. The maximum dose rates at the water edge in the ditch leading to the ponds were about 200 mrads/hr including 160 mR/hr. Analysis of samples show that the water in the three ponds is at or below 5×10^{-5} μCi/cc fission products. The radioisotopes present are mostly $ZrNb^{95}$ and $Ru^{103\ 106}$. Specimens of ducks removed from one of the ponds disclosed no external contamination."

October 2, 1967

"The west bank of the Redox #1 swamp was observed to have broken under the pounding of water from high winds during the weekend. A 25-foot wide gap had allowed water from the higher #1 swamp to drain into the lower #3 swamp. Three-fourths of the bottom of the #1 swamp was left exposed and drying. #2 swamp left without a water supply had receded to a fifth of its former size.

216-S-16 continued

History:

Radioactivity from exposed surfaces in the three swamps was found to be as follows:

#1 Swamp

General contaminates: 4,000 to 20,000 c/m. One area to 80,000 c/m. 95,000 c/m found on small area in ditch entrance to the swamp. Very little radioactivity found on new algae in bottom of the pond.

#2 Swamp

General contamination from 2,000 c/m to 6,000 c/m with a few spotty areas ranging to 15,000 c/m. Tumbleweeds taken from areas of soil averaging 6,000 c/m were found to contain less than detectable radioactivity with a GM survey meter. A gamma scan, however, showed traces of Cs-137 and Ru-106.

#3 Swamp

The few exposed ground surfaces in this water-filled swamp were less than 1000 c/m radioactivity.

May 1969

Waste water flowing from the Redox 202-S Building into the Redox Ponds was greatly reduced during the period to comply with the Commission's request for improved management of our surface waste water.

Formerly, water was introduced to the pond feed stream in excess of that amount needed to operate the 202-S "D" Cell waste evaporation system. In theory, the excess water was needed to keep the contaminated bottoms of Ponds #1 and #2 below water level so as to prevent weed growth and spread of contamination by wind.

Since the reduction of flow, Pond #2 has dried up except for a small pool in the deepest part, and small beaches have developed on the east side of Pond #1. Exposed contamination in both ponds ranged from 300 c/m to 8,000 c/m beta-gamma contamination. The beaches of Pond #1 have been covered by one foot of gravel. The entire bottom surface of Pond #2 is receiving from six inches to one foot of gravel and is one-third complete at this writing. The job is to be finished by June 6, 1969. Radioactivity above graveled surfaces is less than 200 c/m.

216-S-16 continued

History:

Note:

The work in #2 Pond consisted of scraping the top six inches of those portions of the pond bottom that were contaminated into the borrow trench along the inside base of the south dike. The trench was approximately eight feet deep. All contaminated soil went into the bottom of the trench, then three feet of clean soil was bladed in and topped with one foot of clean gravel to bring it up to grade level. The bladed clean surfaces of the pond bottom were topped with six inches of gravel to help stabilize the pond bottom against wind erosion.

June 1975

"The J.A. Jones Company completed their contract on the 276-S-16 Redox Pond Complex June 20, 1975. The work included the removal of the pond dikes to use in filling over the contaminated surfaces in Ponds #1 and #3 and also the covering of the 216-S-16 Ditch. The contaminated surfaces of these areas before covering ranged to a maximum of 3000 c/m in Pond #1 and the ditch, and to 1000 c/m in Pond #3. All of the area, a total of 19 acres, is now free of surface contamination."

Note:

The work was accomplished in every detail as outlined in the attached letter of recommendations. The cross discings reduced readings in the bottom of the pond from 2000 c/m to 500 c/m beta-gamma activity.

216-S-16 continued

History:

Date: April 2, 1975

To: R. B. Guenther

From: H. L. Maxfield

Subject: STABILIZATION OF THE 216-S-16 REDOX POND #1

The following work is recommended for stabilization of the Redox Pond #1 surface against migration of radioactive contamination:

1. Wet down the ground surface of the #1 pond to prevent the movement of radioactive dust during plowing.

2. Thoroughly mix the surface soil by turning under with a disc plow to a depth of 8" or greater. Disc the surface twice, one perpendicular to the other.

3. Work the surface with water and blade or drag until large clods are broken up and a smooth surface is prepared for a seed bed and asphalt treatment. Keep dust to a minimum.

4. Apply asphalt emulsion and soil sterilant to the staked area in the center of the pond.

5. Backfill with soil from the dikes around ponds #1, #2, and #3 and from as much of the south dike of Pond #4 as is necessary. The soil over the asphalt treated area to be at a minimum fill of 30 inches, then shaded out to the perimeter of the pond using all the available fill material. Keep fill soil free from dust by application of water during the fill.

6. Fertilize the area with 100 lbs. 16-20-0 fertilizer and 100 lbs. Of 21-0-0 fertilizer per acre of surface.

7. Seed with 20 lbs. of hard red wheat seed per acre.

8. Spread sixty 70 lb. bales of wheat straw evenly over each acre. Work the straw into the soil until the straw is anchored firmly in the topsoil. This is best done using an offset disc. The straw should be left sticking above ground to offer a wind shield against wind erosion.

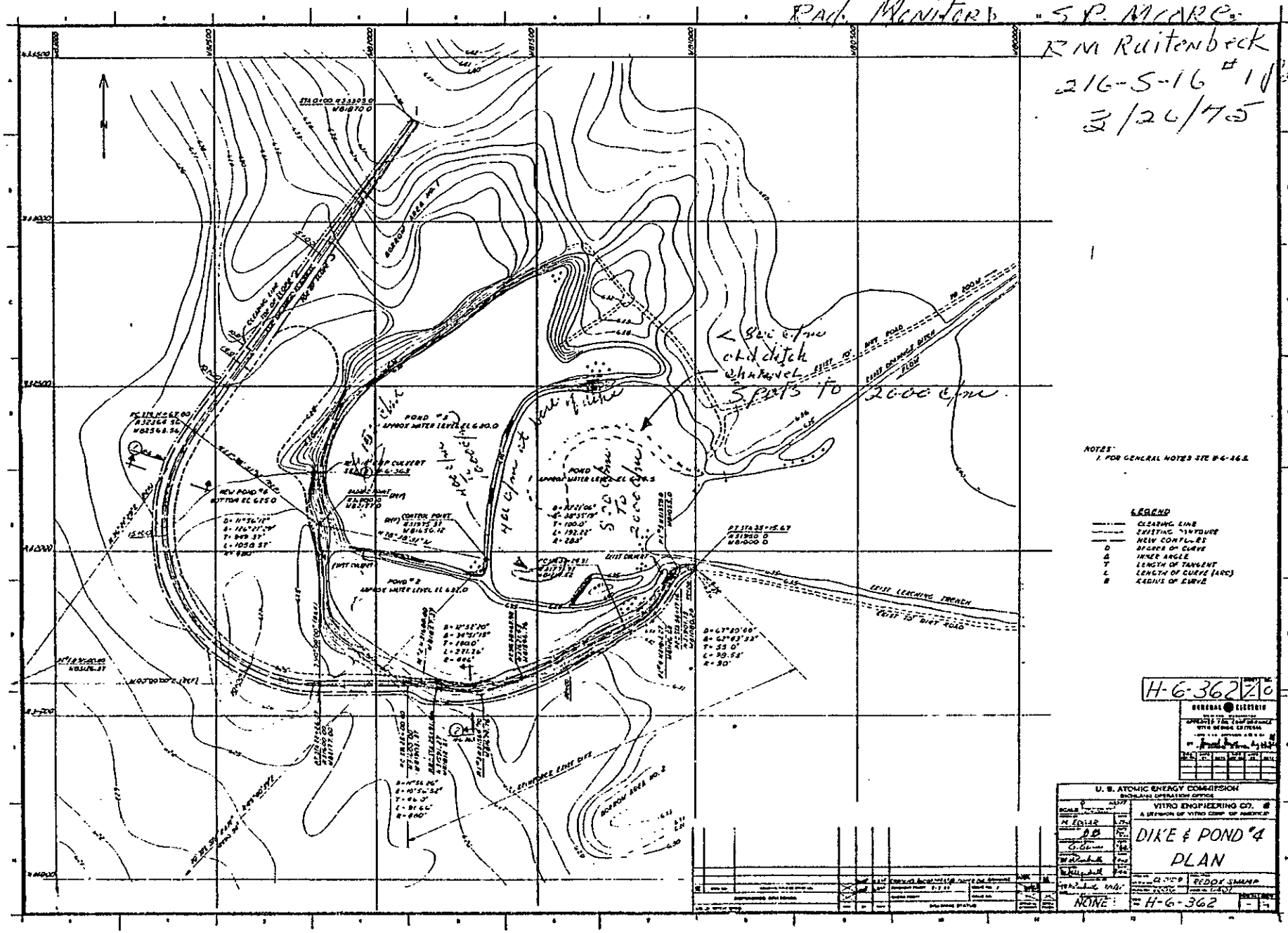
9. Water with a spray tanker until the topsoil is saturated.

HLM:nlb (HLM:kkc)

9 2 1 2 3 1796

Also field beppy (Pam) for alpha activity

Pond Monitored - S.P. McCarley
R.M. Ruitenbeck
216-S-16 #1 Pond
3/26/75



RHO-CD-673

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Pond	202-S Swamp 202-S Redox Swamp 216-S-1 Redox Pond #1	216-S-17

Location	Service Dates	Status
Outside - 200 West, South Quadrant 3743 ft southwest of 202-S 2983 ft south of Perimeter Road West of the 216-S-10 Pond and Ditch	10/51-3/54	Inactive - covered

Site Coordinates	Reference Drawings	Elevations	
H-31680, W-77350 N-31180, W079738 N-31635, W-79738 N-32950, W-78265 N-32950, W-77350	H-2-2594	Ground Water Table Site Depth	651 ft 471 ft(1973) 0 (surface)

Source and Description of Waste

6.43 x 10^9 liters. 10/51-1/53 Process cooling water and steam condensate from 202-S. 1/53-4-54 202-S effluent; overflow from 216-U-10 Pond via 216-U-9 Ditch.

Description of Facility

Pond, 17 acres.
Deactivation: Pipeline to the pond plugged north of 216-S-5 crib; pond area covered with clean earth. (Radionuclide inventory in sediments exceeded prescribed limits.)

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	3.0	3.0
Beta, Ci	1.1 x 10^3	< 7.55 x 10^1
^{90}Sr, Ci	40.	2.15 x 10^1
^{106}Ru, Ci	50.	1.46 x 10^{-6}
^{137}Cs, Ci	30.	1.68 x 10^1
^{60}Co, Ci	none	None
U, kg	1.4 x 10^2	1.36 x 10^2

Summary

See next page.

216-S-17 continued

Summary

A series of leaks in process vessel coils in the Redox 202-S Plant, beginning early in October 1952 released radioactivity into the 207-S Retention Basin and on out to the 216-S-17 Pond. The pond was taken out of service March 15, 1954 and subsequently backfilled with clean dirt. The fill over the 3 or 4 acres nearest the pond inlet is approximately 48 inches deep. No radioactive weeds have been observed growing in the sterile course black sand used in the fill. However, there has been considerable surface erosion from winds. That portion of the covered pond is generally free from surface contamination.

The original backfill (1954) over the remainder of the pond has been found to be from 12 to 18 inches deep. Core samples taken show a definite ring of vegetable matter approximately 1/2 inch thick at the location of the old pond bottom. Fully 90% of the radioactivity remaining in the pond is trapped in this mat of vegetation.

In January of 1970, radioactive Russian thistle were found to have grown over a major portion of the covered pond. The weeds were removed and buried in a 15-foot deep by 75-foot long trench on the south side of the covered pond, but within the radiation zone.

In November of 1971, the pond area was seeded to Siberian wheatgrass to compete for moisture against the undesirable Russian Thistle; which is notoriously known to seek out and bring radioactive strontium and cesium to the ground surface. A good growth of this grass remains excepting where it was later covered.

In the spring of 1974, a 4-foot fill of dirt was placed over approximately 7 acres of the pond where radioactive weed growth was the most prevalent. Four acres of the fill area on the southeast portion of the pond is presently being used by Battelle-Northwest (BNW) as a test plot to demonstrate contamination control by ground surface stabilizing techniques.

Conclusions

1. Approximately 10 or 11 acres of the pond has been covered with a 36 to 48-inch fill of clean dirt which presently is free from radioactive plant growth.
2. A minimum of 6 additional acres should be covered with 48 inches of fill dirt to preclude further radioactive plant growth.
3. The remaining radioactivity is predominately strontium-90 and cesium-137. Continued surveillance of the area will be necesary.

216-S-17 continued

Historical excerpts from Redox Radiation Monitoring Reports:

October 1952

"Followup investigation of an above normal reading on the 207-S Retention Pond HM chamber lead to the discovery that gross amounts of contamination was being sent to the pond and the Redox swamp via the process cooling water. Surveys of the swamp revealed the area to be generally contaminated with a maximum dose rate of 2 rep/hr including 35 mr/hr at one inch from ground surface being detected. Dose rates up to 50 mrep/hr including 18 mr/hr both measured at five feet from the surface of the water at the 207-S pond were observed. Vegetation removed from the pond gave dose rates to 2.2 rep/hr including 80 mr/hr at two inches. Analytical results of this vegetation revealed approximately 42 uc of Beta activity per gram of sample. Approximately 75% of the activity was due to Rare Earths with only a few percent of the activity due to Ru, Zr, or I.

Investigation of possible sources within the building revealed that the D-12 waste concentrator had a steam coil leak."

November 1952

"Although the activity of the process cooling water dropped considerably following replacement of the D-12 cooling coil last month, sporadic increases were detected by the 207-S monitoring chamber early this month. Investigation showed that a similar leak in the H-4 coil existed. An attempt was made to prevent contamination of the cooling water by keeping pressure on the coil at all times pending its replacement at the next scheduled shut down. As the coil rupture became worse, this failed, and gross amounts of contamination were again being discharged to the Redox swamp late in the month. During a three-day period, dose rates increased from 20 to 200 mr/hr at two inches from the process cooling water header, from 80 mrep/hr including 40 mr/hr to 250 mrep/hr including 70 mr/hr approximately five feet above the water at 207-S, and from approximately 6 mrep/hr to 700 mrep/hr including 30 mr/hr six inches above the water at the swamp inlet."

December 1952

"Following replacement of the H-4 pot, the activity of the process cooling water dropped to values between 10^{-5} μc/cc. Positive activity was still evident, but was probably due to flushing of the contaminated line. A serious problem was discovered, however, when wild fowl were observed feeding on the grossly contaminated swamp. A duck was killed on the swamp showing a dose rate of 100 mrep/hr at surface. In an effort to keep fowl off the swamp, colored balloons were anchored around the swamp and a continuous noisemaker was installed. This was apparently successful, since no further birds were seen. High dose rates were observed on a particular form of vegetation at the swamp. A dose rate of 5 rep/hr including 300 mr/hr was measured at three inches from one mass of this material. In some cases, the vegetation was entangled in tumble-weeds, which could easily be spread outside the swamp area by windstorms.

216-S-17 continued

History:

February 1953

"Replacement of the D-12 pot eliminated this source of contamination of the Redox swamp, but a leak in the D-4 coil continued to allow low-level contamination to be discharged to the swamp."

April 1953 WASTE AREAS:

"Solvent naphtha was introduced into the Redox swamp late in the month in an effort to kill vegetation and thus make the area less attractive to wild fowl. The result of the experiment cannot be evaluated as yet."

May 1953

Solvent naphtha into the Redox swamp was discontinued when no evidence of vegetation kill could be found.

July 1953

"The following recommendations were received from the Biology Section as being the best methods of eliminating vegetation at the swamp and thus discouraging use of the swamp by wild fowl: Copper sulfate added to the water; 2, 4-D sprayed over the swamp; and sodium chlorate broadcast by hand at the periphery of the swamp. These steps will be taken as soon as possible and will be continued during the fall migratory period. Evaluation of the measures will be done by Biology. Surveys downwind of the swamp indicated that no detectable contamination had been spread by the wind."

August 1953

" A leaking coil in the H-4 pot was detected near the end of the month. Since the spare was not yet completed, operations in H-4 continued, attempting to minimize leakage into the coil by maintaining pressure on the coil at all times. This was not completely successful, however, as dose rates rose from 25 to 180 mr/hr two inches from the utility outlet header and from 30 to 350 mrep/hr approximately five feet above the water at 207-S.

September 1953

"The leak in the H-4 pot coil became worse rapidly. Before the coil was blanked off, dose rates rose to 2 rep/hr over the 207-S Retention Basin and to 1 r/hr at 2 inches from the utility outlet header. Replacement of the H-4 pot eliminated this as a source of further contamination going to the Redox swamp, but another leak in the D-12 pot coil was discovered late in the month."

216-S-17 continued

History:

February 1954

"Contamination surveys around the Redox swamp indicate the contamination remains reasonably fixed. Dose rates at the swamp edge are as high as 1500 mrads/hr surface, which is comparable to previous survey results. No contamination was detected at the temporary fence isolating the new underground swamp project."

March 1954

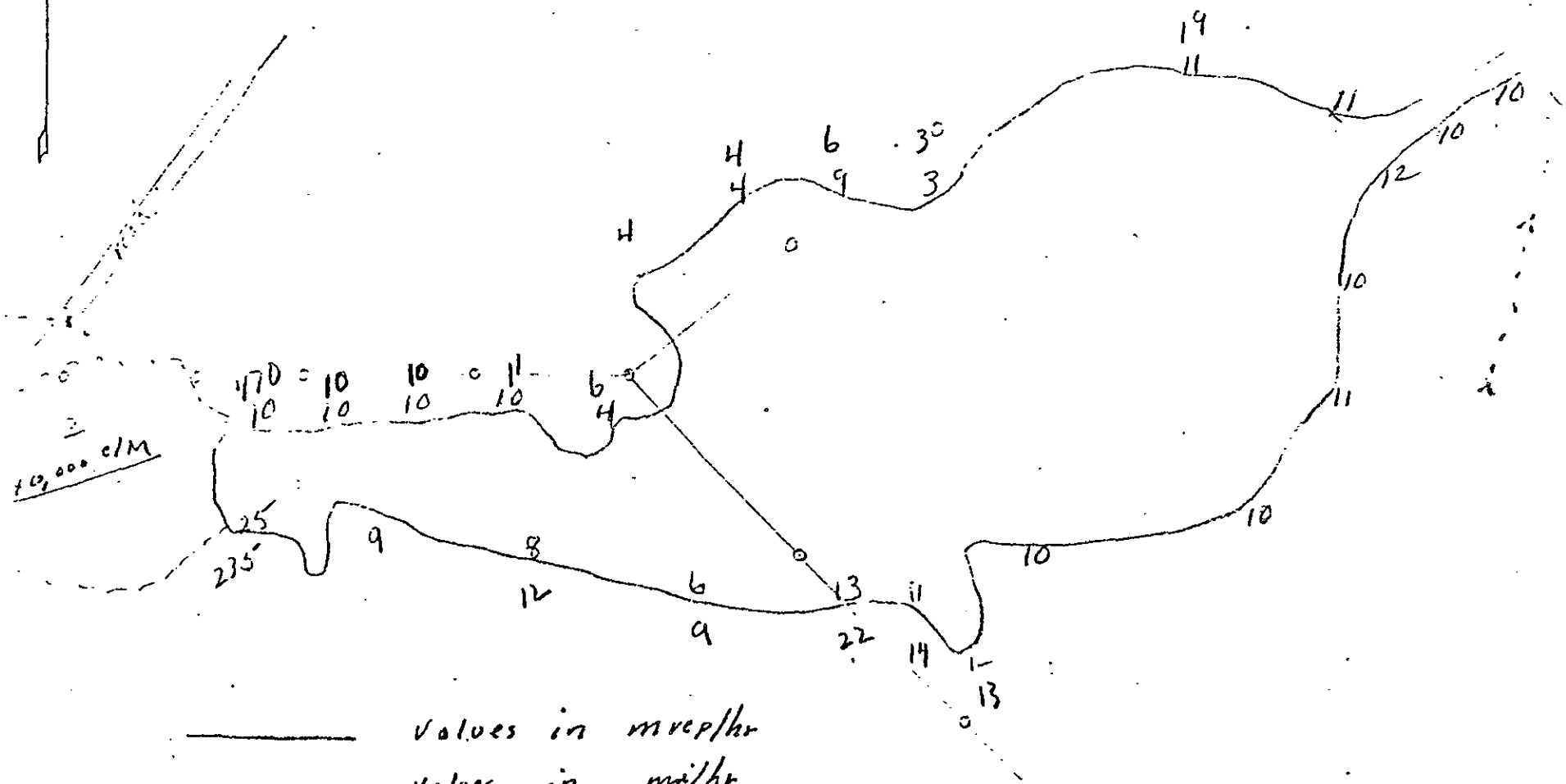
"Redox swamp was bypassed on the 15th of the month and Minor Construction forces are filling the original swamp. The retention pond will be bypassed and backfilled during current scheduled shutdown."

March 1, 1979

An inspection of the 216-S-17 covered pond site revealed surface contamination resulting from decomposed radioactive Russian Thistle and other weeds that have grown over the pond area since 1956. Those areas that have received additional soil overfill were found to be free of surface contamination; but the lower ground surfaces, approximately 10 acres, are in need of attention.

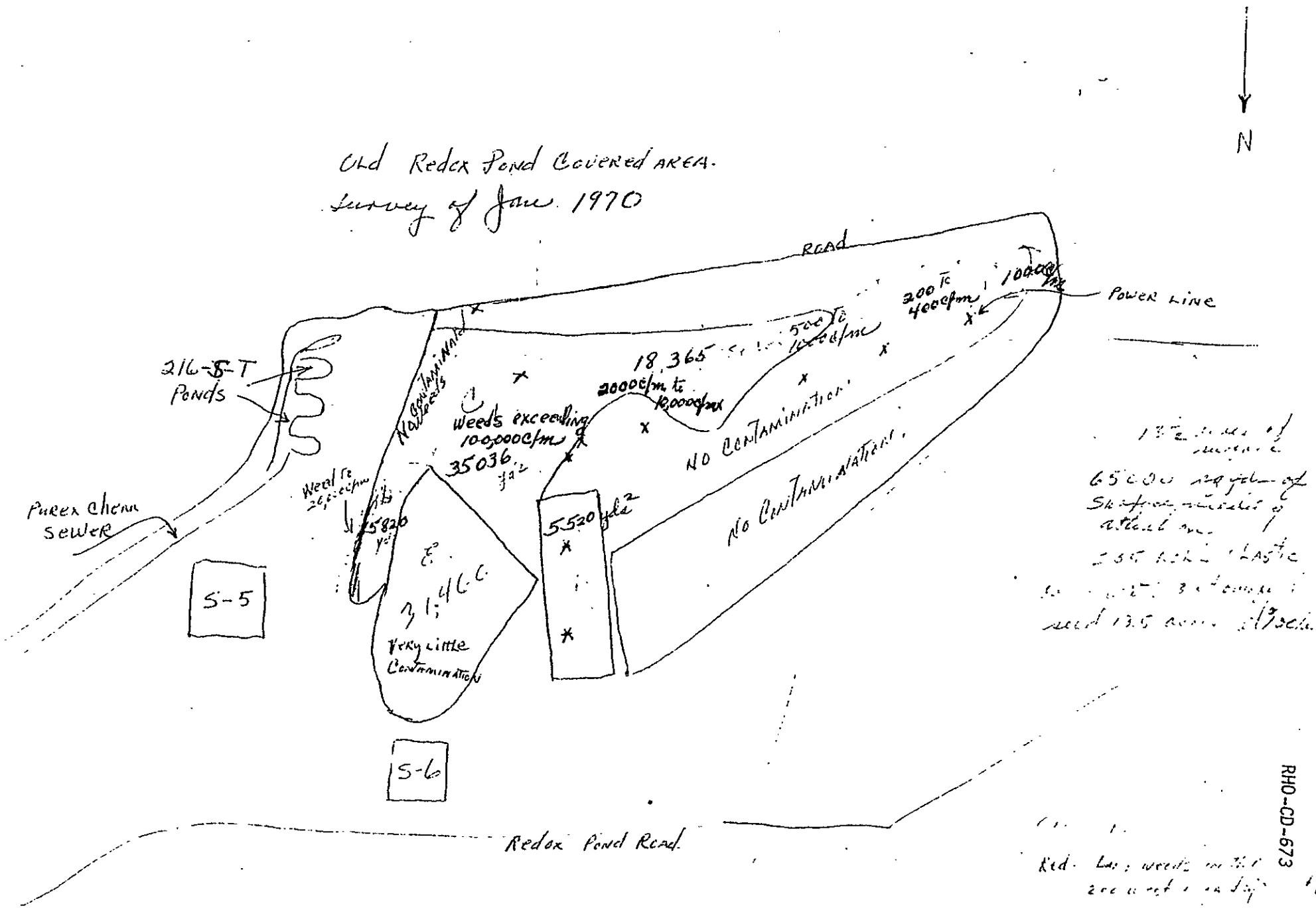
The cover crop of Siberian Wheatgrass has greatly reduced the growth of other plant life, particularly the Russian Thistle, but there are still enough growing radioactive Russian Thistle to constitute a radioactive transport problem, as is evidenced by the wind blown radioactive Russian Thistle lodged in the willows bordering the nearby 216-S-10 Ditch.

Survey 1 of Radio Swamp Area 2



10/7/52
by Regional Survey

RHO-CD-673


Old Redox Pond Covered AREA.
Survey of June 1970
N
ROAD
POWER LINE
200 to 400 cfm
216-S-T Ponds
Contaminated Weeds
Weeds exceeding 100,000 cfm
35036 yd²
18,365
2000 cfm to 10,000 cfm
500 to 1000 cfm
NO CONTAMINATION
NO CONTAMINATION
Purex Chem Sewer
5820 yd²
5520 yd²
S-5
Very Little Contamination
S-6
Redox Pond Road
RHO-CD-673

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Pond	222-S Lab Swamp 216-SL-1 Redox lab Swamp	216-S-19

Location	Service Dates	Status
Outside-200 West, South Quadrant 2432 ft southeast of 202-S 1767 ft south of 10th Street	2/52- to Present	Active

Site Coordinates	Reference Drawings	Elevations	
N-32200, W-72910 N-31840, W-72650	H-2-34762 H-2-5224 H-2-32525 H-2-44510	Ground Water Table Site Depth	660 ft 461 ft (1973) 0 (surface)

Source and Description of Waste

7.28×10^8 liters. Effluents from 222-S Laboratory (ventilation cooling water; misc. wastes from lab hoods and decontamination sinks via 207-SL Retention Basin.

Description of Facility

Pond, 3.5 acres.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/78
Pu, g	21.	2.06×10^1
Beta, Ci	3.3×10^2	<6.88
^{90}Sr, Ci	< 2.5	<1.76
^{106}Ru, Ci	< 6.8	$<1.82 \times 10^{-3}$
^{137}Cs, Ci	< 2.3	<1.68
^{60}Co, Ci	< 0.56	<0.118
U, kg	$<1.1 \times 10^2$	1.10×10^2

History:

In December of 1953, surface dose rates up to 200 mrads/hr were detected at the edge of the 222-S Swamp. Over the ensuing years the beta-gamma radioactivity has decayed off until presently there is no activity detectable with Radiation Monitoring type field instruments.

216-S-19 continued

History:

Tests were conducted on February 12, 1974 in which an employee traversed the entire area, and no measurable radioactivity was found on his protective clothing.

Mud samples taken from the site July 14, 1977, contained Americium 241 activity to 38 nanocuries per gram.

It is recommended that a rock-filled type trench be constructed through the center of the site into which the waste water can be diverted to the bottom of the trench, thus eliminating surface water.

Name/Type of Facility	Past Designation	Number
Crib		216-S-25

Location	Service Dates	Status
Outside-200 West, South Quadrant 300 ft south of 13th Street. 2800 ft northwest of 202-S. Outside the 200 West perimeter fench, south and east of 216-U-10 Pond.	1/73 to Present	Active

Site Coordinates	Reference Drawings	Elevations	
N-35520, W-76220 to N-35520, W-76850	H-2-46286 H-2-46291 H-2-46292	Ground Water Table Site Depth	663 ft 475 ft(1973) 10 ft

Source and Description of Waste

6.96×10^6 liters. 242-S Process and steam condensate.

Description of Facility

Crib, bottom area 5750 ft^2.

Radionuclide Content (calculated from discharge data)

Radionuclide	At Time of Discharge	As of 6/30/77
Pu, g	<0.01	<0.03
Beta, Ci	<0.01	<0.464
^{90}Sr, Ci	<0.01	<0.036
^{106}Ru, Ci	<0.01	<0.058
^{137}Cs, Ci	<0.01	0.066
^{60}Co, Ci	<0.01	<0.064
U, kg	<0.07	1.82
^{3}H		173.0

CONTAMINATED LIQUID DISPOSAL SITES

Name/Type of Facility	Past Designation	Number
Ditch	U Swamp-S Swamp Ditch 216-U-6	216-U-9

Location	Service Dates	Status
200 West, Outside-South Quadrant North end of ditch starts 2000 ft west of 271-S Tank Farm at end of Dayton Avenue. (Old outlet from 216-U-10 Pond.)	*12/52-4/54	Released from Radiation Zone Status

Site Coordinates (Approximate)	Reference Drawings	Elevations	
N-35750, W-78050 N-35900, W-77000	H-2-2430	Ground Water Table Site Depth	662 ft-648 ft 470 ft(1973) 6 ft

Source and Description of Waste

Overflow from 216-U-10 Pond.

Description of Facility

Ditch, 6 ft wide and 3500 ft long. Deactivation: Bottom area of trench backfilled with two feet of dirt, spring of 1954.

Radionuclide Content (calculated from discharge data)

No Data Available

History:

Redox Radiation Monitoring Monthly Report - April 1969:

"4/15/69 - Five test holes were bored to a depth of 8 ft in the bottom of the old trench leading from "U" Swamp to the old Redox covered swamp. The holes were bored at each end of the trench and near the center of the trench. No contamination was detected. It is recommended that this trench area be released from a radiation zone status. Several other holes were bored on the perimeter of the Old Redox Swamp. No contamination was detected outside of the known boundaries of the swamp.

(See Next Page)

216-U-9 continued

History:

In 1973 four trenches approximately four feet deep were cut across the 216-U-9 Ditch at intervals to determine the radiation status of that facility. No radioactivity was found. Again, when a new trench was cut from the 216-U-10 Pond to provide an overflow route to the 216-S-16 Pond, the new routing was dug in the first 500 feet of the 216-U-9 Ditch. No radioactivity was encountered in the digging.

The ditch has been released from the status of a radiation zone.

*Redox Radiation Monitoring Report - December 1952 reported the following items:

> The ditch between the U-Swamp and the Redox swamp was completed and water started overflowing into the Redox swamp during the month.

Name/Type of Facility	Past Designation	Number
Trench	U-Swamp Extension Ditch 216-U-11 Ditch	216-U-11 (old ditch)

Location	Service Dates	Status
4940 ft southwest of 221-U. Runs under Dayton Ave., heading straight west from 216-U-10 Pond.	11/44-8/55	Inactive Partially Backfilled

Site Coordinates	Reference Drawings	Elevations	
N-36630, W-78075 to N-36630, W-78650 N-36630, W-79550 to N-36630, W-79850	SK-2-1888 M-26000 W #23 and 24	Ground Water Table Site Depth	660 ft 475 ft 6 ft

Source and Description of Waste

Volume unknown. Overflow from U-10 Pond.

Description of Facility

Trench, 1960 ft x 5 ft bottom dimension (810 ft of the trench used as part of the new 216-U-11 trench). Deactivation: bottom area of ditch backfilled.

Radionuclide Content (calculated from discharge data)

<0.1 Ci Beta

NOTE: The new 216-U-11 Ditch cuts out the center portion of the old 216-U-11 Ditch and is common with it; but is now designated the 216-U-11 Ditch.

Name/Type of Facility	Past Designation	Number
Trench	U-Swamp Extension Ditch; 216-U-11 Trench 216-U-12	216-U-11 (new trench)

Location	Service Dates	Status
Outside-200 West, South Quadrant 4940 ft southwest of 221-U, 230 ft west of Dayton Ave.. West of the 216-U-10 Pond.	8/55-	Inactive

Site Coordinates	Reference Drawings	Elevations	
N-37450, W-78375 N-36630, W-78670 N-36630, W-79575 N-37760, W-78685	H-2-2430 H-2-32527 SK-2-1888	Ground Water Table Site Depth	660 ft 475 ft 6 ft

Source and Description of Waste

Volume unknown. Intermittent overflow from 216-U-10 Pond.

Description of Facility

Trench, 3440 ft x 5 ft (includes 80 ft of old 216-U-11 Ditch).

Radionuclide Content (calculated from discharge data)

<0.1 Ci Beta

History:

The south portion of this ditch is common with the Old 216-U-11 Ditch.

A radiation survey taken in January 1978 disclosed residue radioactivity (beta-gamma) to a maximum of 2000 c/m in the bottom of the trench and around to the southwest corner of the site. There is also a flood plain in the south quarter of the facility that was at one time inundated with contaminated waste water from the 216-U-10 Pond. This surface has remaining radioactivity to 2000 c/m.

(See Next Page)

216-U-11 (New Trench) continued

History: cont.

1/13/78: Analyses of soil samples taken from the ground surface of the bottom of the overflow trench were as follows:

Sample Location	Concentrations in pCi/gram Dry Weight ^{40}K	$^{89\ 90}Sr$	^{137}Cs
East side	13.6	36.0	108
West side	13.3	130.0	67
North end	13.9	55.7	1390